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Electrical Review.

VOL. XVII.—No. 398.

THE INVENTIONS EXHIBITION.

VERY few people, we believe, will be found who regret the continued popularity and success of the international exhibitions which have for the past three years attracted thousands upon thousands to the pretty gardens of the Horticultural Society at South Kensington—excepting, of course, those who have, or imagine they have, sustained actual loss through the competition of a specially favoured rival. These exhibitions have professedly been conducted so as to combine in a conspicuous manner sound and useful instruction with a healthful and charming form of mild amusement; and so well has this intention hitherto been carried out, that the only wonder would be if they did not succeed in gaining a firm hold on the public favour. They have catered, and catered eminently well, for that part of the public which has desired to be instructed and for that which sought only to be amused, as well as for that other very considerable portion which has been anxious to obtain a modicum of both instruction and amusement.

When, however, the real motive of the original project is, as it is now, in danger of being lost sight of, and that part of the concern which alone can rightly be termed the exhibition seems likely to be made subservient in all respects to the capital that can be made out of the adjunct which was intended only to give breathing space and recreation to those who visit the exhibition proper, it is time for the representatives of the public to call attention to the matter and insist that those who are responsible for the conduct of the enterprise shall not be allowed to go on in whatsoever manner pleases them best, unquestioned and unchecked. Murmurs of various kinds have reached our ears as to the spirit which has actuated the management of the present Inventions Exhibition, or at any rate as to the manner in which that spirit has been interpreted by those occupying subordinate positions in connection with the exhibition. With the more general question of the conduct of the huge enterprise we will not attempt to deal. What calls for our more immediate attention is the treatment meted out to those in whose interest ostensibly the whole affair exists, and the product of whose brains and industry has been made to serve the purpose of attracting silver and gold to the exchequer of the promoters. But scant courtesy in many ways have the exhibitors met with at the hands of the managing authorities; and we wonder that they have submitted so meekly to the indignities they have been subjected to. Here is what we should imagine to be a legitimate grievance: upon certain nights the use of the exhibition is granted to this or that learned society for the holding of a reception, fête, or conversazione, call it what you will, and at an early hour—six o'clock, we believe—on these particular evenings the exhibitors are requested to withdraw. We greatly question the wisdom of this procedure. We know not whether the exhibitors were aware when they contributed their respective quota to the show at South Kensington that upon four nights during the season they would be debarred from remaining in attendance upon their exhibits, whilst what a friend of ours terms a "civilized crowd" roamed through the buildings. It was a lack of foresight on their part not to have had some understanding on this point, perhaps; and no doubt they have suffered, and will suffer, in consequence. But, beyond this, we should have thought that it would be a distinct advantage that some one should be in charge of the various pieces of mechanism and machinery, to give a description of them to those who, of all others, should be best able to give an intelligent audience; the interest in the exhibition would thereby, according to our view, be greatly augmented, and certainly the exhibitors would expect to derive very considerable profit from an exposition of their wares in such company. The question to many may not seem one of very great importance, but we are quite sure that if the management of the Inventions Exhibition would take a different view of the matter, and allow the exhibitors the opportunity of remaining upon these special nights, they would have no cause to complain, would increase the attractiveness of the exhibition to their distinguished visitors, and would earn a greater amount of popularity than they now enjoy amongst those who have contributed so largely to the success of their undertaking.

THE MEASUREMENT OF RE-DRESSED OR ADJUSTED CURRENTS.*

By E. HOSPITALIER.

IT is not always sufficient to possess industrial apparatus of measurement, perfectly standardised, voltmeters and ampèremeters, and to adapt them suitably to a circuit in order to deduce from their indications the true value of the electric energy expended in the circuit.

We commit gross errors if we do not take account of the *form* of the current and of the *nature* of each measuring instrument.

This is what we purpose demonstrating theoretically and practically, making known the first results of our experiments on this important question. We have been led to this study in consequence of an observation made in March last, at the Exhibition of Electricity, on one of the lamps of M. Anatole Gérard, whose machine with four poles and adjusted currents is well known to our readers.

An incandescence lamp supplied by M. Gérard's machine, would seem to require a much less consumption of electrical energy than if it was supplied with strictly continuous currents, such as those furnished by accumulators, the current and the difference of potential being measured in each case with the same apparatus, that is, with an ampèremeter and a Deprez-Carpentier voltmeter.

---

* *L'Electricien.*

We have been able to determine experimentally these differences with the assistance of the pupils of the School of Industrial Physics and Chemistry of the City of Paris, thanks to the courtesy of M. A. Gérard who has placed at our disposal, in his work rooms, one of his machines, and a Gramme machine giving currents so slightly undulatory that they might be regarded as continuous.

The comparisons were made by bringing the lamps to the same luminous intensity and measuring:

1. The current with a Siemens electro-dynamometer and a Deprez-Carpentier ampèremeter;
2. The difference of potential at the terminals of the lamps with a Thomson voltmeter, a Deprez-Carpentier voltmeter and a Deprez-d'Arsonval galvanometer, previously standardised.

Our experiments brought into prominence the following facts:—

1. Whatever may be the form of the current, the electro-dynamometer furnishes always the same indications for the same luminous intensity.
2. The ampèremeter yields an indication lower by 10 per cent. with adjusted currents than with continuous currents.
3. The voltmeters according to their nature, and for reasons which we shall explain immediately, furnish indications lower by 13 to 17 per cent. with adjusted currents than with continuous currents, say on the average 15 per cent.

We are thus led, if we consider the indications of these apparatus, the electro-dynamometer excepted, as exact, to ascribe to the lamps an outlay of 23·5 per cent. less in watts with Gérard's machine.

In reality it is nothing of the kind, and the cause of these apparent anomalies lies in the form of the current and in the nature of the apparatus employed for measurement.

If we refer to Joule's formula:

$$W = R I^2 t$$

we see that the energy, W, expended in an electric circuit during a given time, t, is proportional to its resistance, R, and to the square of the intensity, I. If the current is variable during the time, t, as in Gerard's machine, the energy expended during the time, t, is proportional to the mean of the squares of the intensity and is consequently proportional to the indications of the electro-dynamometer, which gives precisely the mean of the squares. An ampèremeter like that of Deprez-Carpentier gives only the mean intensity, and it is easy to see that except in the case of an absolutely continuous current the square of the mean intensity is always smaller than the mean of the squares of the intensity.

It is only in the case of I being constant that

$$\left(\frac{1}{T}\int_0^{T} I\,dt\right)^2$$

representing the square of mean intensity and

$$\frac{1}{T^2}\int_0^{T} I^2\,dt$$

representing the mean of the squares of intensity have the same value.

With a current of a perfect sinoidal form, calculation shows that the difference of the intensities reaches 10 per cent., the exact figure found by experiment.

If we take Joule's formula in the form

$$W = \frac{E^2}{R}\,t$$

reasoning analogous to the above shows that the indication of a Deprez-Carpentier voltmeter cannot when raised to the square, give more than the square of this difference of mean potential, always less than the mean of the squares of the differences of potential.

Theory in the case of a perfectly sinoidal current indicates a difference of 10 per cent.

In fact, the difference is greater because the self-induction proper to the voltmeter produces in the case of variable currents a counter-electromotive force which diminishes the intensity in the circuit of the voltmeter and further lessens the indications. This cause of error naturally varies with the coefficient of self-induction in the measuring apparatus. This explains the differences of the indications of the different voltmeters employed when making use of fluctuating currents, whilst these differences are nil with continuous currents.

Conclusions.

Ampèremeters and voltmeters which by their principle of construction furnish indications respectively proportional to the mean of the intensities and to the mean of the differences of potential are not fit for measuring adjusted or very undulatory currents, and furnish too low values for the product E I.

With currents of this kind it is necessary to employ apparatus whose indications are proportional to the mean of the squares. Moreover, as far as voltmeters are concerned, the coefficient of self-induction must be nil, or so small that it may be neglected.

The electro-dynamometer of Siemens is fit for measuring currents, and the quadrant electrometer (idiostatic method) and Cardew's voltmeter may serve for measuring the differences of potential. The product of their indications gives the true value in watts of the mean electric power, whatever may be the form of the current. Their use does not admit of the reservations which we have just made concerning the magnetic apparatus, which hitherto have been almost exclusively used industrially.

It is then indispensable before procuring a measuring apparatus, to know very exactly all the peculiarities of the currents for which it is destined, for fear of committing serious errors and losing all the benefit of its use.

A NEW ELECTRO-DYNAMOMETER.

By J. W. GILTAY.

Reprinted from the *Annalen der Physik und Chemie.* New Series. Vol. XXV., 1885.

THE apparatus described below is principally intended for measuring telephonic alternating currents. The apparatus constructed for this purpose by Ader is probably better adapted for demonstrations than for measurements. Kohlrausch's electro-dynamometer gives an indication of 1 millimetre on a scale at the distance of 2 metres, when a current of $\frac{1}{17000}$ ampère is transmitted. The dynamometer of Siemens has about the same sensitiveness. But as, according to Bosscha, alternating currents of 77×10^{-8} ampère suffice to produce a distinct sound in a Bell telephone, a higher degree of sensitiveness than that of the instruments just named is very desirable for telephonic measurements. Certainly the two last-mentioned apparatus are not constructed for this purpose.

Bellati has indicated a perfectly novel principle for the construction of an electro-dynamometer.

If in a galvanometer an iron rod is substituted for the magnetic needle and suspended in the plane of the coils, it is not deflected by the current passing through the coils, because it is not magnetic. If the rod is placed in the meridian plane and at the same time vertical to the plane of the coils, it is magnetised by the current passing through them, but it is as little as before deflected from its position because it has already the maximum deviation—90°. But if the rod makes with the plane of the coils an angle smaller than 90°, it is both magnetised and deflected by a current passing through the coils. As the polarity of the iron rod is reversed with the direction of the current, the deviation will always take place on the same side whatever may be the direction of the current. Hence it follows that alternating currents will occasion a movement of the iron rod.

Bellati has tried his principle only with a quite provisional apparatus. The results are so satisfactory that I undertook to construct an apparatus on his system which I shall shortly describe. I must mention that Vincenti, in his researches on the resistances of saline solutions, made use of a Bellati dynamometer, though without a mirror scale.

To a round wood disc (fig. 1) is fixed a frame of vulcanite, *a*, quite similar to that which is used in Nobili's multiplier. Around this frame are passed 2,400 turns of a copper wire 0·1 millimetre in diameter. This wire is divided into four parts, each of 600 turns. Both ends of each part are connected with two adjacent binding-screws and can thus be combined in different manners. When all the coils were connected in a single series the resistance of my instrument was 408 ohms.

The frame is covered with a plate of vulcanite on which are drawn two white lines—the one perpendicular to the plane of the coils; the other forming with it an angle of 45°. On the metal ring, R, are three brass pillars supporting the round plate, P. Into this plate is screwed a brass piece into which the glass tube, B, is cemented. In order to protect the apparatus from currents of air, a metal screen (fig. 2) is placed over the plate, P. It fits into the ring, R, and is provided with a side-opening closed with a piece of mirror glass.

In fig. 3 is represented the iron bundle with the mirror; *c*, *d* is a vulcanite tube forming one piece with the rod, *a*, *b*. Into the tube, *c*, *d*, is introduced a bundle of iron wires, each 18 mm. long and 0·4 mm. in diameter; *e*, *f* is a light indicator parallel to the axis of the bundle of wires, and consisting of a white hog's bristle. Into the upper side of *a*, *b* is screwed a brass wire, *g*, *h*, to which the plane mirror is fixed. This is 20 millimetres in diameter, is movable round the rod, *g*, *h*, and can thus be placed in any desired vertical plane. The entire system is suspended by two cocoon threads, 30 centimetres in length, and about 0·3 millimetre from each other.

The instrument is set up in such a manner that the plane of the coils forms an angle of 45° with the magnetic meridian. The screen is now brought in such a position that the white line on the vulcanite plate forms an angle of 45° with the coils. By turning the brass rod in the glass tube to which the cocoon threads are fixed, the index, *e*, *f* (fig. 3), can be placed exactly over this white line. In this case the bundle of iron wires forms an angle of 45° with the plane of the coils and is perpendicular to the magnetic meridian and consequently withdrawn from the induction of terrestrial magnetism. When all this has been effected, the screen is turned until the glass plate is opposite the mirror.

The time of oscillation of the suspended system is about 15 seconds; the point of return can therefore be very conveniently read off in the mirror and noted down.

The following measurement shows that the zero point is sufficiently constant. Fig. 4 shows how the alternating currents used for this purpose are excited. A is a small induction apparatus, the primary wire of which is connected with a Bunsen element, B, and the Neeff hammer is set in vibrations; the secondary circuit remains open. At the distance of a few centimetres from the inductor is a Bell telephone, T. The successive appearance and disappearance of magnetism in the iron core of the inductor induces changes in the magnetism of the iron core of the telephone, whereby alternating currents arise in the bobbin of the telephone and are conducted to the dynamometer, D. The currents thus excited are tolerably constant, at least if the contact screw of the hammer is properly fastened and the platinum contact is thoroughly cleaned. For measurements of long duration the arrangement is insufficient as the Neeff hammer sometimes suddenly begins to vibrate more slowly or more rapidly, thus modifying the intensity of the induction currents.

Five successive points of return are noted each time, and the centre of the vibration is thus determined.

At first the zero point was determined, then the alternating currents were passed through the instrument, the circuit re-opened and the zero point determined again.

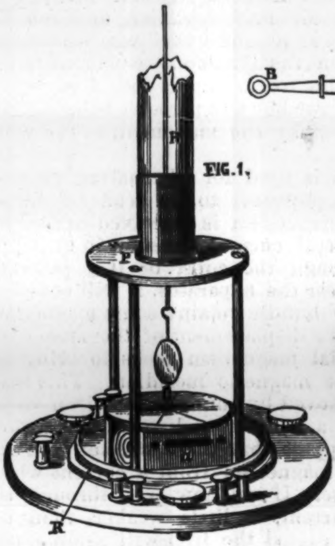


FIG. 1.

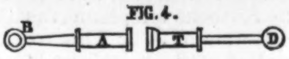


FIG. 4.

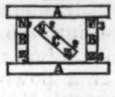


FIG. 5.

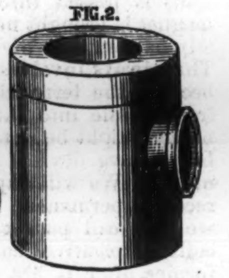


FIG. 2.

In the first column of the subjoined table are the various values found for the zero point; in the second column is given the middle point of the vibrations which the iron cylinder makes when the alternating currents pass through the instrument.

Zero point.	Middle point of the vibrations when the current passes through the apparatus.
137·06	...
137·23	223·87
136·58	222·72
136·78	222·37
136·68	221·88
136·70	222·32

As it will be seen, the zero point changes but very little, but it is essential that the temperature of the room should remain tolerably constant. A rise of temperature of 10° C. causes the zero point to vary by about 80 mm., following the fluctuations of the temperature of the room with tolerable regularity.

FIG. 3.

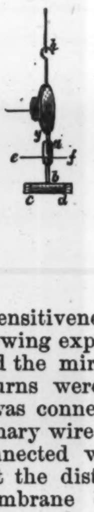


FIG. 6.

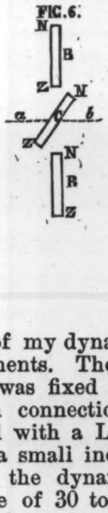
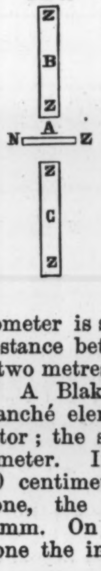


FIG. 7.



The sensitiveness of my dynamometer is shown by the following experiments. The distance between the scale and the mirror was fixed at two metres; all the 2,400 turns were in connection. A Blake microphone was connected with a Leclanché element and the primary wire of a small inductor; the secondary was connected with the dynamometer. If anyone spoke at the distance of 30 to 40 centimetres from the membrane of the microphone, the dynamometer gave a first deviation of 30 mm. On speaking very gently into a Siemens telephone the instrument gave a first deviation of 100 mm. The speaking in these experiments was always continued rather longer than half the period of the vibration of the suspended system. As the currents excited in the telephone by speaking change every moment in their intensity, I could only observe the first deviation and not the constant deflection. If a loud "Oh" was called into the Siemens telephone, the dynamometer showed a first deflection of 90°. This angle could not, of course, be read off with the mirror but was perceived through the window in the screen by the movement of the white index.

If the instrument is used for alternating currents which are not too powerful to be read off in the mirror, no residual magnetism is perceived in the iron bundle. If a powerful current, constant in its direction, is passed through the coils, or if a powerful magnet is brought near the apparatus, it will occasionally happen that the bundle retains some magnetism. This always involves a displacement of the zero point because the terrestrial magnetism seeks to bring the iron bundle into the magnetic meridian. This magnetism might be removed by annealing the iron wires, but I have devised a simpler and equally efficacious means. We will suppose that the bundle of iron has received permanent magnetism from a current which we will call positive. If we now pass through the coils a negative current, a little weaker than the former, after it has ceased the iron will again retain some permanent magnetism, but the bundle will now have a north pole where it had previously a south pole, and as the negative current was weaker than the former positive one, the magnetism retained in the bundle becomes weaker than before. If, therefore, alternating currents of decreasing intensity are passed into the instrument, the permanent magnetism becomes weaker and weaker and at last entirely disappears. For this purpose I connect with the instrument a Siemens telephone and utter the vowel O at first loud but becoming gradually fainter. When the sound has entirely ceased the iron bundle has completely lost its permanent magnetism. The following experiment shows the truth of this assertion.

The zero point was at the beginning of the measurement 181·5. A powerful induction current was then passed into the instrument excited by suddenly pressing the iron plate of the Siemens telephone. Before leaving the plate the circuit was again interrupted. The deflection disappeared entirely out of the field of the telescope. After the iron bundle had come to rest it was found that the zero point had become 126, the iron bundle therefore retaining permanent magnetism. The circuit was closed again and the vowel O was called into the telephone in the manner described above. The iron bundle made oscillations of about 178·5, and after it had come to rest the zero point was found 178·5. The telephone was then connected with the dynamometer in the reversed direction, when therefore the induction current excited by pressing in the iron membrane passed through the apparatus in the reversed direction. If the iron bundle was permanently magnetised by this current its north pole must be where formerly was its south pole. This was really the case, as appeared from the fact that the zero point had now become higher. The mirror when at rest showed 300. After a fainter "O" had been spoken with the instrument the zero point returned to 179·0.

As is seen, the permanent magnetism of the iron bundle is very completely removed in this manner. It happens, however, occasionally that this experiment must be repeated several times before the original zero point is restored. The cause is probably that the iron bundle makes very great oscillations when the vowel O is spoken and thereby is brought for a short time into a position parallel to the coils. As long as the iron bundle is parallel to the coils or forms with them only a small angle, it is withdrawn from the magnetising action of the currents passing through the instrument. If after some time it returns to a position such that it forms a considerable angle with the coils and is therefore again exposed to their magnetising action, it may happen that the induction currents excited in the telephone are not of sufficient intensity to reverse the residual polarity. In consequence the bundle retains a certain magnetisation.

In order to obtain an accurate result it is desirable to place the iron bundle perpendicularly to the coils and then to let down the cocoon threads until the index lies on the vulcanite plate.

For small deviations the theory of the instrument is very simple. Let us assume that the iron bundle when placed vertically to the coils receives the magnetic momentum, c, μ, i, by a current, i, passing through the instrument. If it is deflected in an angle, γ, the momentum will be only

$$c_{1}, i, \mu \;.\; \cos.\, \gamma.$$

The momentum of torsion exerted by a current, i, on a rod of the magnetic momentum 1, which forms an angle of $90 - \gamma$ with the plane of the coils, is proportional to $i \sin \gamma$. The momentum of torsion exerted by the current upon our iron bundle (which has the magnetic momentum c_{1}, i, u . cos. γ) is therefore :

$$\mathrm{K} = \mathrm{C}\, i^2 \mu \;.\; \sin.\, \gamma \cos.\, \gamma. \qquad (1)$$

In Bellati's dynamometer the iron bundle when at rest forms an angle of 45° with the coils. If a current passing through the coils produces a deflection, a, the bundle will form with a line perpendicular to the plane of the coils an angle $45 - a$. In order, therefore, to find the momentum of torsion exerted upon the iron bundle by a current, i, we must substitute in (1) $45 - a$ for the angle γ.

$$\mathrm{K} = \mathrm{C}\, i^2 \mu \;.\; \sin.\, (45 - a) \cos.\, (45 - a)$$

This momentum of torsion is counter-balanced by the torsion of the suspensory wires, and as this in a bifilar suspension is proportional to the sine of the deflection :

$$\text{Const. } i^2 \mu \;.\; \sin.\, (45 - a) \cos.\, (45 - a) = \text{const. } \sin.\, a.$$

$$i^2 = \mathrm{C} \frac{\sin.\, a}{\sin.\, (45 - a) \cos.\, (45 - a)} = \mathrm{C} \frac{\sin.\, a}{\frac{1}{2} \cos.\, 2\, a}$$

$$i^2 = \mathrm{C} \frac{\sin.\, a}{\frac{1}{2}\,(1 - 2 \sin^2 a)}.$$

If a is small $\sin^3 a$ may be neglected and it is therefore

$$i^2 = \mathrm{C} \sin.\, a,$$

and as likewise when a is small sin. a is proportional to tan. 2 a, the deflection read off on the scale is proportional to the square of the intensity of the current.

For greater deflections the instrument must be graduated. For this purpose alternating currents, the respective proportion of intensity of which is known, must be passed into the coils and a curve constructed accordingly. But as the facilities for this experiment were wanting, I endeavoured to attain the same object by the application of currents of constant direction, which, however, did not succeed, as in this case the terrestrial magnetism had a greater effect upon the iron bundle than the current traversing the coils. The earth's magnetism seeks to bring the bundle into the meridian plane and reinforces the action of the coils or counteracts it according to the direction of the current passing through the instrument. It was found that not merely the magnitude, but the direction of the deflection varies with the direction of the current. A current of $\frac{1}{130000}$ ampère was passed into the instrument in a certain direction : the deflection was 24·8 mm. to the right. The current was reversed and the deflection was then 22·8 to the left. Hence it follows that the earth's magnetism has a considerably more powerful action upon the bundle than has the current passing through the coils. The graduation of the instrument in this manner is therefore not possible.

The iron bundle can be withdrawn from the action of terrestrial magnetism if the coils are combined in such a manner that the current passes in the left half of the frame in the opposite direction from in the right. The iron bundle thus has three poles, *e.g.*, a south pole in the middle and a north pole at each end; if the position and the strength of the poles are correct the bundle will be astatic. In this case the apparatus can be graduated by means of currents of uniform direction. But as the magnetising and deflecting effects of both halves of the coil act in opposition to each other, it was to be feared that with this combination of coils the instrument would be much less sensitive, as was found to be the fact. Alternating currents excited in the manner indicated in fig. 4 were passed through the instrument; with the ordinary combination of coils the deflection was 155·3 mm., but with an astatic magnetisation only 14·9. As the apparatus in the latter case is far less sensitive I pursued this idea no further.

The instrument can therefore be graduated only by means of alternating currents. As a matter of course the determination of the constant cannot be effected with currents of uniform direction. They can be found only by introducing the instrument into a circuit along with a dynamometer whose constant is known, and passing the same alternating currents through both apparatus.

I have further endeavoured to increase the sensitiveness of the instrument by introducing two iron bundles in two horizontal apertures of the vulcanite case. From the respective position of the poles of these three bundles (fig. 5) it may be seen that the bundles, B, B, tend to bring the bundle C into a position vertical to the plane of the coils, and thus to reinforce the action of the current upon C. It was found, however, that the sensitiveness of the instrument was somewhat lessened by this modification. The cause is probably that the pole, N_2, in consequence of the proximity of N_1, and in like manner Z_2 by the proximity of Z_1, is less powerfully magnetised than when the two bundles, B, B, were not present. In consequence the deflecting action of the current upon the bundle, C, will be slighter than before. What is gained by this modification on the one hand is lost on the other.

A better arrangement which I have not yet had the opportunity of testing is probably that given in fig. 6. C is the suspended iron bundle; B, B are the fixed bundles; *a*, *b* is the plane of the coils between which C is suspended. The bundles, B, B, are likewise surrounded by the current and obtain the magnetisation indicated in the figure. If the current is reversed all the six poles are altered and the direction of the deflection remains the same.

As we have already seen the magnetism of the earth produces a considerable deflection if a galvanic current of small intensity is sent through the coils. This induced me to try in how far Bellati's dynamometer could be used as a galvanometer. The principle of this galvanometer is quite different from that of all other galvanometers. Whilst in an ordinary galvanometer the earth's magnetism acts in opposition to the deflection of the needle and we therefore seek to diminish this influence by astaticism, in my instrument the earth's magnetism is used for the very purpose of deflecting the iron bundle, whilst the current serves exclusively for magnetising the bundle.

For this purpose the instrument was turned 45° from its former position, so that the plane of the coils was brought into the magnetic meridian. The iron bundle was turned so that the white index was parallel to the line which is perpendicular to the plane of the coils. The iron bundle was therefore perpendicular both to the coils and to the magnetic meridian. When I passed into the instrument a current of 0·00000125 ampère there resulted a deflection of 6·7 millimetres at the distance of 1·9 metre between the mirror and the scale. Although this cannot be termed extraordinary sensitiveness for a mirror galvanometer, the result is fairly satisfactory for so simple an apparatus. If we may assume that the stiffness of the cocoon threads does not change notably the constant of this instrument will be liable to fewer changes than is the case in a common galvanometer, as my instrument contains no permanent magnet.

To render this galvanometer more sensitive we must endeavour to reinforce the action of the earth's magnetism. This might be effected very simply by introducing two permanent magnets, as shown in fig. 7, where A is the suspended iron bundle, and B, C, the fixed permanent magnets. The polarity of A depends naturally on the direction of the current passing through the instrument. When the magnets, B and C, are powerful enough, the action of the earth's magnetism may probably be disregarded, and the instrument may be placed in any desired position as regards the magnetic meridian. This instrument has, however, a disadvantage: copper damping is inapplicable. As the iron bundle is only very feebly magnetic it can induce, by its movement merely, damping currents of slight intensity.

I have hitherto had no opportunity to test the galvanometer when fitted with these additional magnets.

The theory of this galvanometer without the extra magnets is as follows, for small deflections: If μ, i, is the magnetism induced by the current, i, in the iron bundle when placed perpendicular to the plane of the coils if there is a small deflection, α, the induced magnetism will be $\mu\, i\,.\,\cos.\,\alpha$. The couple of forces exerted by the earth's magnetism upon the iron bundle will then be const. $\mu\,.\,i\,.\,\cos.^2\,\alpha$, and as it is kept in equilibrium by torsion,

$$\text{const. } \mu\,.\,i\,.\,\cos.^2\,\alpha = \text{const. } \sin.\,\alpha.$$

$$i = \text{C}\,\frac{\sin.\,\alpha}{\cos.^2\,\alpha} = \text{C}\,\frac{\tan.\,\alpha}{\cos.\,\alpha}.$$

For a small α $\cos.\,\alpha = 1 : i = \text{C} \tan.\,\alpha$. Further, for a small α we may take $\tan.\,\alpha = \frac{1}{2}\tan.\,2\,\alpha$, and then the deflection as read off on the scale is directly proportional to the intensity of the current.

The directive action of the coils upon the iron bundle and the magnetism induced by the earth in the bundle are both proportional to sin. α, and may be neglected when α is small.

MICKLEWRIGHT'S AERIAL ELECTRIC SIGNALLING APPARATUS.

THE object of this apparatus, the invention of Mr. F. J. Micklewright, is to cause a code of signals to be visible either by day or by night at a greater distance than by any other method hitherto used. It is well known that ordinary signals can be seen only short distances, and that signalling by means of reflected light as employed for military purposes is useless after sunset, and also when the sun is covered with clouds. Signalling by means of flags has also been used, but these signals can be seen short distances only, or, if long distance signalling be required, a large number of men are necessarily employed.

In Mr. Micklewright's invention a current of electricity is conveyed from a battery or dynamo by wires in the usual manner to a switch board, and thence by means of an insulated cable to a frame containing one or more electric lamps or semaphore indicators, the current being carried to the lamps or semaphores by the requisite number of wires in cable. The frame may be affixed to any convenient object having a sufficient altitude for the purpose for which the signals are required; for instance the frame may be attached to a ship's mast, or to a lighthouse, or to a lightship, or to a fort held by a beleagured garrison, or the frame may be attached to a captive balloon so that from an altitude a code of signals may be visible for a long distance. By switching the current on and off, one or several of the semaphore indicators can be caused to appear from their boxes or cases in the day time, and the electric light being caused to shine in the incandescent lamp or lamps at night, signals are thus rendered visible from any desired altitude. Any code of signals and any coloured lamps or semaphore indicators may be used.

When a larger apparatus is required, the inventor provides a dynamo machine driven by an engine or other motive power, the dynamo being connected to a switchboard. In communication with the switchboard a cable is fixed, containing any number of wires requisite to make contact with the lamps or semaphores employed, the cable passing from the switchboard to an armature and drum constructed in the following manner. The drum on which the cable is wound has a metal spindle with two flanges to prevent the cable slipping off, and has a ratchet wheel and pawl and brake to control the revolutions of the drum, the spindle having a square end to which a handle is fixed to haul down balloon and frame. On the other end of the spindle, inside the flange, an aperture is made for the cable to pass through from the armature, which consists of a wood or other insulator having on its outer side strips of metal, underneath which conducting wires are connected to binding screws on the inner end of the armature. Attached to the frame on which the drum and armature revolve, and immediately under the armature, is a block of insulated material, to which is screwed metal brushes corresponding to the number of metal rings on the armature, so that the cable is always in contact with the electric current. A runner, or traveller, and snatch block with running wheel for the cable may be attached to the frame of the drum to prevent upward strain on the drum when a balloon is employed. The cable having passed over the snatch block communicates with a frame which consists of an outer band of thick cane, wood, metal, or other suitable material, having apertures in the sides to admit of cross bars, preferably three, made of wood or metal having at their ends a metal socket terminating in a pin which fits into the aperture at each side of the frame so as to give a level position to the lamps or semaphore indicators which are attached to the cross bars aforesaid. The frame is so made that it can be opened at will, and the cross bars with semaphores which are used for day signalling exchanged for cross bars fitted with electric lamps, either incandescent or arc lamps, according to the electric force required. The cable is attached to the frame, and the wires are insulated and conducted to the lamps or semaphores, the frame being attached to a captive balloon which is inflated in the ordinary way. If desired, the signals may be made from a large balloon by the person or persons in the car of same, telephonic communication being made from below, as required, to signal movements. This arrangement combines an apparatus for signalling and reconnoitring.

FIG. 3.

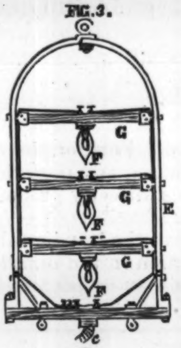


FIG. 5.

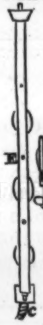


FIG. 1.

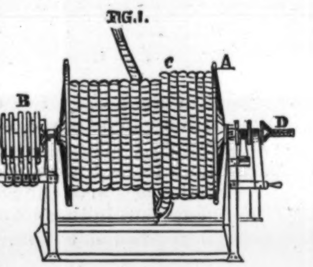


FIG. 4.

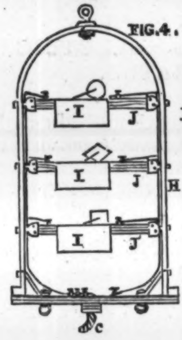


FIG. 6.

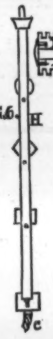


FIG. 2.

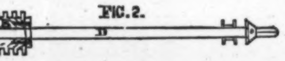


FIG. 7.

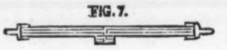


Fig. 1 is an elevation of the drum, A, and armature, B, showing the cable, C, wound on drum, A.

Fig. 2 is a section of drum spindle, D, and armature, B, showing how the electric contact is made from switch board to armature, B, and from armature to drum spindle, D, to which the cable, C, is attached.

Fig. 3 is an elevation of frame, E, showing electric contact from cable, C, to lamps, F, F, F, on cross bars, G, G, G.

Fig. 4 is an elevation of frame, H, showing electric contact from cable, C, to semaphore indicators, I, I, I, on cross bars, J, J, J.

Figs. 5 and 6 show end view of frames, E and H, with interchangeable lamps and semaphore indicators.

Fig. 7 is a section of cross bar.

RADIATIONS EMITTED BY INCANDESCENT CARBONS.

By M. FELIX LUCAS.

IF we gradually raise, in contact with the air, the temperature of a non-oxidisable metal, such as platinum, the thermic radiations, at first obscure, become afterwards luminous. M. Pouillet has estimated the temperatures corresponding to the successive colours of the metal, and according to him incipient redness corresponds to 525° C., and dazzling whiteness to 1,500°.

We observe an analogous phenomenon if we heat carbon strongly, keeping it in a vacuum to prevent combustion. At a temperature sufficiently high we have incandescence; the carbon becomes a real focus of light. There is evidently a relation between the intensity of the light emitted and the temperature of the carbon, and as we have to do with an infusible body, it is not impossible to raise it to temperatures considerably higher than the melting point of platinum. I have thought that experiments carried out in this direction would offer a great interest, theoretical and practical. My attempts have not remained fruitless, and I am about to describe (*Comptes Rendus*) the results obtained as briefly as possible.

The carbons which I used are of the same nature as the artificial carbons at present used in our lighthouses for the production of the voltaic arc; they are manufactured by M. Carré. The surface, which is rendered luminous, is cylindrical, and measures 450 square millimetres; the right section of the ring is 5·6 square millimetres. The carbon is placed in the vacuum obtained at the pressure of 0·001 metre, by means of a pump obligingly placed at my disposal by M. Carré. A particular arrangement enables me to pass into this carbon in a permanent manner an electric current, the strength of which can be raised up to 200 ampères. I obtain this current by connecting together two de Méritens magneto-electric machines, which possess each two circuits of 40 bobbins formed by uniting in quantity 10 groups of four bobbins joined in series. By taking the whole or a part of the four circuits and varying their connections, and by modifying, on the other hand, the speed of rotation, I have been able to give the strength of the electric current different values between 40 and 200 ampères.

In each experiment the current strength, I, is given by a Siemens electro-dynamometer introduced in the outer circuit. Knowing the manner of connection of the circuits of the magneto-electric machines and the velocity of rotation, I can (by means of the formulæ which I have previously established concerning the action of these machines) calculate the resistance, R, of the external circuit corresponding to each value of I. On deducting from R the portion corresponding to my metal conductors (which are so bulky as not to become sensibly heated) I obtain, for each value of I, the value ρ of the resistance of the luminous carbon. I have been able to establish empirically the formula

$$\rho = \rho_0 \frac{0{\cdot}0175\ \text{I} + 1}{0{\cdot}140\ \text{I} + 1} \qquad (1)$$

in which $\rho_0 = 0{\cdot}26$ ohm is the resistance of the carbon cold, previous experiments have moreover enabled me to ascertain that the resistance, ρ, is connected to the temperature, θ, of the carbon by the formula

$$\rho = \rho_0 \frac{0{\cdot}0007\,\theta + 1}{0{\cdot}0056\,\theta + 1}. \qquad (2)$$

By means of the formulæ (1) and (2) I find

$$\theta = 25\,\text{I}. \qquad (3)$$

This simple relation permits me to estimate the temperature of the carbon in each of my experiments.

The determination of the luminous intensity, γ, corresponding to each value of I or of θ, has been made by means of a Degrand's photometer.

Each of the results obtained represents the mean of three to seven experiments; the luminous intensity is given in carcels.

Current strength. I	Temperature. θ	Luminous intensity. γ
Ampères.	Deg.	Carcels.
40	1,000	3
75	1,875	16
110	2,750	79
125	3,125	106
140	3,520	212
150	3,750	317
165	4,125	390
175	4,375	390
180	4,500	413
190	4,750	420
200	5,000	413

Taking I as an abscisse and γ as an ordinate, we obtain a curve to which the following equation may be assigned:

$$\gamma = \frac{\text{I}^4}{0{\cdot}00528\,\text{I}^4 - 206\,\text{I}^2 + 3660800}. \qquad (4)$$

At the outset γ increases as the fourth power of I; the curve presents a point of inflection for $\text{I} = 140$ and $\gamma = 212$; it then turns its concavity downwards and rises until its tangent becomes horizontal, which takes place at $\text{I} = 188{\cdot}52$ and $\gamma = 420$. The corresponding temperature is 4,713° C. *If we carry the current strength or the temperature higher we merely diminish the luminous intensity.*

It is probable that the thermic radiations, which are at first obscure and then successively luminous from redness to whiteness finally pass beyond the violet rays, thus ceasing to be luminous. With a current of 200 ampères, to which corresponds a temperature of 5,000° C., we only obtain 413 carcels, 7 carcels of the maximum intensity being thus lost.

THE INFLUENCE OF STORMS UPON UNDERGROUND TELEGRAPH LINES.

By M. BLAVIER.

ON beginning, some years ago, the construction of the great underground lines which now connect the principal towns both in France and in Germany, it was thought that their conductors would be completely uninfluenced by storms. These wires insulated with gutta percha and placed together as a cable, are protected by a sheathing of iron wires, or by a continuous cast-iron tube, and we know that bodies placed in a medium surrounded by a metallic casing in communication with the earth remain in a neutral state whatever may be the external electric condition.

It has been nevertheless observed that there are sometimes produced in stormy weather, in telegraph offices connected by underground wires, electric discharges which fuse the fine wires of the lightning guards. These accidents are much less frequent and less severe than in the cases where the wires are aerial, and they do not seem to be of such a nature as to interfere with the transmission of dispatches. They correspond always to storms which occur in the country, at some distance from towns where the underground telegraph wires are protected by the net of water and gas pipes below which they are placed.

Thus, for instance, during a violent storm which burst on March 9th last over the middle of the line which connects Belfort to Besançon, sparks were observed at the two extreme stations though the atmospheric perturbation was scarcely suspected in the two towns.

This phenomenon, contrary in appearance to the theory of static electricity may be explained, it seems, either by an effect of electro-dynamic induction or by an effect of electrostatic induction.

If the telegraph wire is buried only at a slight depth in a badly conductive soil, as it often happens on lines, the coating, under the influence of storm clouds, takes a more or less considerable electric charge, even when the internal wire remains in a neutral condition. At the moment when the lightning flashes this charge is suddenly liberated, at least in part, and escapes into the earth, following the metallic coating in two opposite directions.

There must in the first place be developed in the internal conductor two induced currents in opposite directions, the difference of which only can act upon apparatus at the terminal stations. It seems, however, that the resulting effect must be very feeble, the rather because the free electricity rapidly escapes into the ground when the induction can only be very limited.

A second effect may result from the circumstance that the discharge of the coating not being instantaneous, its electric potential decreases abruptly for an instant, however brief. The free electricity reacts upon the internal conductor which is suddenly charged with contrary electricity at the points in contact with the soil, that is, by the intervention of the lightning-rods and apparatus at the terminal stations giving rise to the phenomena mentioned above. The external charge escaping then, produces in the conductor an electric movement in the opposite direction which follows very closely upon the former and is confounded with it, obliterating it in most cases. Thus it is only in exceptional cases that the influence of storms is observed on underground lines.—*Comptes Rendus.*

A NEW STANDARD CELL.

MR. F. C. VAN DYCK, of Rutgers College, New Brunswick, N.J., in *Science*, says:—Since October last I have made some experiments on the zinc-alkali-copper oxide cell with a view to determine the practicability of some modification of it.

The fact that copper and iron, and perhaps some other metals, dissolve in potassium (or sodium) hydrate when used as cathodes, suggested to me the possibility that the formation of the alkaline cuprate might occur at a definite and practically convenient difference of potential between the electrodes immersed in the alkaline bath. As a matter of fact, I find that a cell mounted with amalgamated zinc, potassic hydrate, and metallic copper, gives, when charged until a blue colour appears, a deflection of a hundred and seventy divisions on the scale of a Thompson galvanometer; the Daniell, mounted with saturated zinc sulphate and copper sulphate, giving a hundred and fifty-six divisions. The zinc-alkali-copper cell is joined by a double key to charging-cells and to the galvanometer, a resistance of over nine thousand ohms being included in the circuit of the latter.

The proper shunt is, of course, employed. This deflection of a hundred and seventy divisions seems to be invariable, and the cell experimented upon promises to be a desirable practical standard of electromotive force. Its excellence appears to consist in the fact that the cuprate produced breaks up before it diffuses to the amalgamated zinc, depositing oxide of copper, which settles. The zinc is suspended about an inch above the copper—which is a spiral ribbon, exposing about two square feet of surface—and the resistance is less than an ohm. I have used a ten-per-cent. solution of "depurated" potassic hydrate. After some trials, it was found that the shifting of the cell from the charging source to the galvanometer circuit may be done leisurely, as the electromotive force does not seem to begin to fall off for some minutes. Further testing of the effect of changes of temperature, strength of solution, &c., is in progress. Thus far, the temperature of the cell has been allowed to vary very little, not enough to affect the readings. I offer this preliminary note as of possible interest to your readers. This type of cell would be admirably adapted to furnish any desired multiple of its electromotive force.

FREEMAN'S TELEPHONIC TRANSMITTER.

THIS invention relates to telephonic transmitters of the class known as battery transmitters, and its object is to utilise for telephonic transmission an intermittent electrical current instead of the so-called "continuous undulatory current" employed in variable-contact closed-circuit transmitting instruments as heretofore constructed.

The invention in part consists, according to Mr. Freeman's version, in breaking and closing the primary circuits of an induction coil rapidly in response to the vibrations of a diaphragm actuated by sound vibrations of the air, and thereby causing the said circuits to be traversed intermittently by strong electric impulses, which have the effect of inducing in the secondary circuit and the line wire connected thereto impulses of alternating direction, having quantity and tension (*sic*) so great that they will travel over very long stretches of line wire, and actuate receiving instruments connected therein with greater force than has heretofore been known in the art of telephony, reproducing articulate speech clearly, loudly, and distinctly; and in part in a novel combination, in a transmitting instrument, of circuit closing and breaking devices with a diaphragm, battery circuits, and an induction coil having two primaries and one secondary coil.

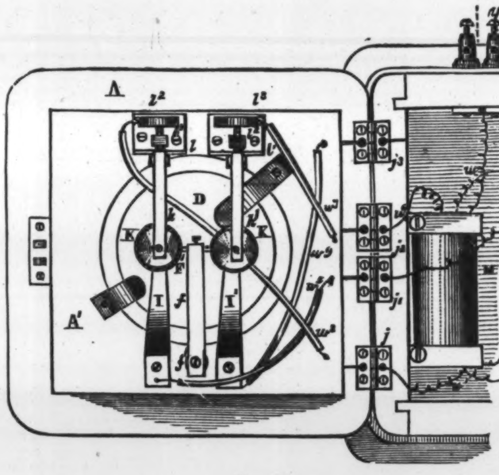


FIG. 1.

In the accompanying drawings, in which similar letters refer to like parts, fig. 1 is an elevation of the transmitter box with its door open to show the interior parts. Fig. 2 is a section of the door and diaphragm in the plane of the vertical diameter of the latter, the circuit closing and breaking devices and induction coil being shown in full lines, and fig. 3 is a detached end elevation of the working lever and electrodes.

Referring to figs. 1, 2, 3, the letter A indicates the box or casing of the apparatus, and A′ is its door, having the diaphragm D, mounted behind an orifice, *a*, therein in the usual manner. From the centre of the rear surface of the diaphragm projects a pin, *c*, and behind this pin is an approximately equal-armed rocking lever, F, pivotted to an arm, *f*, which stands behind the diaphragm, and is supported by a post, *f*′, projecting rearwardly from the door, A′. This rocking lever, F, has inserted through openings in its ends insulating or non-conducting plugs, *g*, *g*, and through these plugs are secured metallic pins, *h*, *h*′, the forward ends of which are arranged to make contact with the tips of metallic spring fingers, I, I′, which project from the door, A′, and stand at a little distance from the rear face of the diaphragm. The rear ends of the pins, *h*, *h*′, are arranged to make contact with the respective carbon electrodes, K, K′, carried by metallic strip springs, *k*, *k*′, projecting from metallic spring arms, *l*, *l*′, which project rearwardly from the door, A′. Each of these spring arms has behind it a post, l^2, through which passes an adjusting screw, l^3, the tip of which bears against the said arm. By means of these screws the arms may be adjusted to cause the springs to hold the carbon electrodes in proper relation to the contact pins. These spring fingers, spring arms, electrodes, rocking lever, and contact pins constitute, in connection with the diaphragm, the circuit closing and breaking devices, and with them the inventor uses an induction coil, M, of peculiar construction, in that it has two primary coils, one of which is preferably arranged within the secondary coil in the usual manner, while the other is wound outside of the secondary coil. He does not confine himself to this form, the essential requirement being only that there shall be two primary coils which act alternately for inducing currents in the secondary. Now, in connecting this coil for use, he connects the outer terminal of the outer primary coil with the spring arm, *l*, and the inner terminal with one pole of a battery, which has its other pole connected with the spring finger, I. The outer terminal of the inner primary coil is connected with the spring arm, *l*′, and the inner terminal of this inner primary coil is connected with one pole of a second battery, the other pole of which is connected with the spring finger, I′. It will now be seen that if the spring finger, I, is in contact with the forward end of contact pin, *h*, and the rear end of said pin is in contact with the carbon electrode, K, the circuit of battery X will be closed through the spring finger, I, contact pin, *h*, carbon electrode, K, strip spring, *k*, arm, *l*, and the conductors, including the outer primary circuit, which connect said arm and spring finger, I, with the opposite poles of the battery. If, instead of the pin, *h*, being in contact with its adjacent spring finger and carbon electrode, the pin, *h*′, should be in contact with the spring finger, I′, and carbon electrode, K′, then the circuit of battery, X′, would be closed through the inner primary circuit, as will be readily understood.

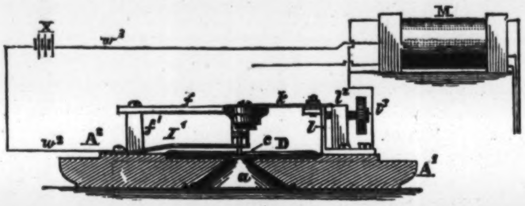


FIG. 2.

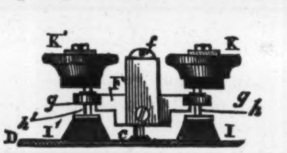


FIG. 3.

The actual mechanical arrangement of the conductors and other parts is partly illustrated in fig. 1, in which the induction coil is indicated by M, the terminals of its secondary coil leading to binding posts. The outer terminal of the outer primary is connected by a wire with one side of the lower door hinge, *j*, from the other side of which a wire, w^2, leads to an arm, *l*. The inner terminal of the outer primary is connected by a wire with a binding post, which is to be connected with one pole of the battery, X,* the other pole of which is to be connected with another binding post, connected by a wire, with one side of the hinge, *j'*, the other side of which is connected by a wire with the spring finger, I. The outer terminal of the inner primary is connected by a wire with one side of the hinge, j^2, the other side of which is connected by wire with arm, *l'*, while the inner terminal of this inner primary is connected by a wire to a binding post. This post is to be connected with one pole of battery, X',* the other pole of which is to be connected to a second binding post, which is connected with one side of the hinge, j^3, the other side of which is connected by a wire with spring finger, I'.

The pin, *c*, at the centre of the diaphragm, touches the inner side of the rocking lever, F, at one side of its pivot and at a point nearer to pin, *h'*, than to pin *h*. The carbon electrode, K, is adjusted to bear normally but lightly on the inner end of pin, *h*, and said pin is always in contact with the spring finger, I. The circuit of the battery, X, is thus normally closed through the outer primary coil of the induction coil. At this time pin *h'* is in contact with spring finger, I', and just out of contact with carbon electrode, K'. Now, if the diaphragm makes an inward half vibration it moves the rocking lever, F, to force the pin, *h'*, into contact with carbon electrode, K', and break the contact of pin, *h*, with carbon electrode, K, thus breaking the circuit of the outer primary coil. As the spring finger, I', follows pin, *h'*, and never breaks contact therewith, the circuit is closed through the inner primary coil as soon as said pin touches the carbon electrode, K', which is immediately after the breaking of the contact between pin, *h*, and carbon, K. Both the closing of one and the breaking of the other produce an inductive effect upon the secondary, and the winding or direction of current in the two primaries is such that the breaking of one induces a current in the same direction as does the closing of the other, and their combined effect is to induce in the secondary very powerful impulses, which flow on the connected line and actuate with great force the receiving instruments included therein. The outer half vibration of the diaphragm of course restores the parts to their normal position, breaking one circuit and closing the other.

While it is true, says the inventor, that there is an instant of time between the breaking of one primary circuit and making of the other, and *vice versâ*, the making and breaking of said circuits are so rapid that every word and every part of every word spoken in front of the instrument is taken up and transmitted clearly and distinctly. This result is due to the peculiar construction of the instruments embodying the invention in each of the forms shown.

The inventor makes no claim to the mechanical construction of the instrument herein described, as that is claimed in his application filed April 21st, 1885, which is a division of this application; but what he claims as new, and desires to secure by Letters Patent, is :—

1. The method of transmitting articulate speech telephonically which consists, first, in causing primary intermittent electrical impulses in the transmitting circuits through the agency of sound-waves due to articulate speech; secondly, causing said primary impulses to generate secondary electrical impulses of an alternating nature; thirdly, causing said secondary electrical impulses to actuate a receiving telephone at a distant station and reproduce said articulate speech accurately and clearly, substantially as described.

2. The method of transmitting articulate speech telephonically by causing intermittent electrical impulses to traverse an electrical circuit, and thereby generate secondary electrical impulses, which secondary electrical impulses in turn actuate a telephone receiver and cause it to accurately reproduce the aforesaid articulate speech, substantially as described.

ALTERNATING CURRENTS FROM CONTINUOUS CURRENT MACHINES.

MESSRS. TROWBRIDGE AND HAYES have devised an apparatus, described in *Silliman's Journal* for May, for producing alternating currents from continuous current machines.

The two free extremities of the principal circuit are connected to two blades, *a* and *a'*, of a four-bladed collector, I, mounted on a fixed axle, A. From the segments, *a*, *a'*, the current passes to the two other segments, *b*, *b'*, the collectors, to which are attached the terminals of the primary circuit of a Ruhmkorff's coil.

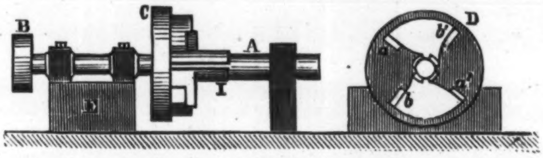


FIG. 1.

The transit from the blades, *a*, *a'*, to *b*, *b'*, is effected by means of four brushes fixed on the surface, D, of a platform, C, and connected two by two as shown in the figure. The platform, C, is mounted on an axle governed by a pulley, B. If we cause the platform, C, to rotate, the direction of the current changes four times in every rotation. In this manner the authors have obtained up to 3,000 inversions per minute.

Their apparatus is perfectly adapted for the study of the musical notes produced in electro-magnets by the rapid inversion of currents, as well as to that of the thermic phenomena which take their rise under the same conditions.

We do not see anything particularly new in this arrangement, as we fitted a Gramme machine with a reverser of a similar nature for experimental purposes in 1879. The accompanying sketch shows the construction of the apparatus.

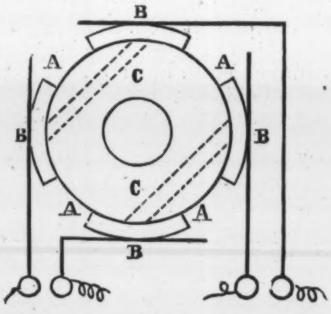


FIG. 2.

An ebonite or wooden cylinder, C, fixed to the axle of the dynamo, had attached to its periphery four metal slabs, A, connected together metallically, as shown by the dotted lines. Four brushes, B, rubbed upon these slabs, and at every revolution of the axle the current was four times reversed.

C

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* Not shown in the drawing.

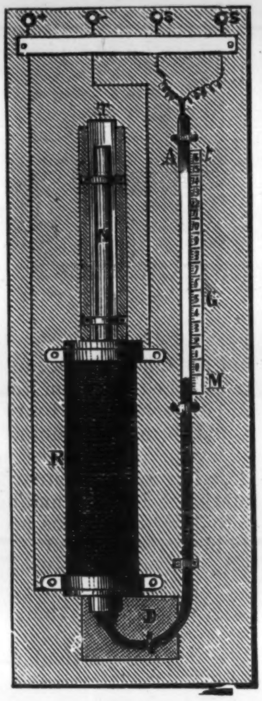
A MERCURIAL AMPÈREMETER AND VOLTMETER.*

By P. MEARDI.

Ampèremeters and voltmeters for industrial uses should satisfy principally the three following conditions :—

1. They should be inexpensive.
2. Not easily liable to injury.
3. Be readily repaired.

These conditions are fully satisfied by the apparatus which I have devised, the former to indicate the increase or decrease of the current strength ; the second to show the variations of the difference of potential between any two points ; the latter has besides to give an alarm when this difference exceeds a given limit. The two instruments are made in the same manner, differing merely in the dimensions and the winding of the coils, which in the former are of fewer folds and of greater diameter, and in the latter the opposite.



A glass tube, T, D, *t*, but in a U-shape at D (see figure), has the vertical arm, T, of greater diameter than the other, *t*. In this tube is placed the mercury, which normally rises to the level, M, in both arms. On the larger arm, T, is fixed a bobbin, R, and within this tube is placed the core of soft iron, N, hollowed internally, and being rather closer at the lower end. Thus it can float slightly immerged in the mercury beneath. It is evident that the bobbin, R, acting as a solenoid, will tend, when traversed by a current, to submerge the said core, whilst the counter-pressure exerted by the mercury, a diamagnetic substance will act antagonistically. The greater this counter-pressure becomes, the greater will be the displacement of the mercury, and the more its level will rise above the normal line in M as the immersion of the iron core in the liquid is greater.

As, then, this immersion increases with the increase of the magnetising action of the solenoid, and as this greater action of the solenoid increases and decreases with the increase or decrease of the current, so the level of the mercury in the tube, *t*, will rise or fall with the increase or decrease of this intensity ; and since both in the case in which the apparatus is arranged to indicate the increase or decrease of the current of the line (ampèremeter), and in the other case for indicating the increase or decrease of the intensity of the current in a parallel circuit (voltmeter), the variations in question will be marked by the upper level of the mercury in the smaller tube, *t*, and on the graduated scale, G.

In the tube, *t*, there are at A two rheophores insulated from each other which, when the mercury reaches a given level corresponding to the maximum tension intended, close a local circuit, to which is fixed an alarm bell.

The apparatus, as it is seen, answers all the conditions announced in the outset.

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* *Il Giorno.*

NOTES.

The Electric Light at Brighton.—At a meeting of the Brighton Town Council on Thursday last week, the Pavilion Committee reported that at a meeting on the 22nd June they considered the report of Mr. Stroudley as to the result of the examination which at the request of the Sub-Committee he kindly made of the electric lighting engines and machinery at the Pavilion ; and the Town Clerk also submitted a letter from Messrs. Robey & Co., in reply to his enquiry as to the price at which they would be willing to undertake the repairs and alterations suggested by Mr. Stroudley, the committee eventually resolving : "That a copy of Messrs. Robey's letter be submitted to Mr. Stroudley, and in the event of his approving of the prices stated therein, that Messrs. Robey be instructed to carry out the work." The adoption of the report was moved by Alderman Lamb, who congratulated the committee on having been in communication with a man of such world-wide experience as Mr. Stroudley. Councillor Challis remarked that as the electric light was to be discontinued during the summer months, he did not think another £100 should be expended on the engine. Councillor Carpenter remarked that the electric light in the Pavilion had been a failure from beginning to end, and was likely to remain so. He moved an exception to the resolution, which was seconded by Councillor Berry, who said that Robey's engine was the worst they could possibly have for the Pavilion, and considering what a failure the electric light had been there, it would be a great pity to spend any more money on the engine. They should see what their own engineer could do with it. Councillor Ballard stated that from enquiries he had made he understood that the water could be turned on from the waterworks on the Race Course, and it would require no labour to keep it going, so that they might do without an engine altogether. Alderman Lamb replied on the discussion, and was constantly interrupted by Councillor Berry, owing to which some personalities ensued. At length the amendment was lost by 19 to 10 votes.

The Electric Light at Hastings.—At the last meeting of the Hastings Town Council it was recommended that an application for permission to erect overhead wires for the supply of electricity between the works in Earl Street and Robertson Street should be refused. Alderman Hennah strongly opposed the recommendation, and thought that the Council should allow the wires to be placed overhead. Why the electric light had not in many cases proved successful was, he believed, owing to underground wires. The permission was ultimately refused.

Shop Illumination by Electricity.—Messrs. J. D. F. Andrews & Co. write us that they have lately installed 65 20-candle lamps at Messrs. R. and J. Dick's boot shop, 296, High Holborn. An Andrew's A/4 Woodside dyname driven by an 8-horse Otto gas engine is employed.

Electric Search Lights in New Zealand.—Messrs. R. E. Fletcher and Company, of Otago, New Zealand, have just constructed an electric search light to be used in connection with the arrangements for the defence of Auckland Harbour. Similar lamps are to be prepared for the other principal ports of the colony. The one already manufactured was tested from the heights near Otago and acted satisfactorily, the light being projected forward in a steady, powerful stream by means of a 22-inch parabolic silvered reflector. The lamp is what is known as "hand-focussing," and is provided with universal motion, so that it can be turned at pleasure by the hand in any direction.

Lawn Tennis by Electric Light.—A number of Philadelphians lately played a game of lawn tennis under the electric light. They say the light was better than the play.

Vetoing the Electric Light in Philadelphia.—Mayor Smith, of Philadelphia, withholds his signature from the Thomson-Houston electric light ordinance. He considers the privileges granted are too great for an electric light company, and gives vent to the following remarkable utterance :—"From and after the present time the executive position will best advance the welfare of our city, and protect and guard the lives of her citizens, and especially those who are officially compelled to brave the dangers incident to fire and its consequent risks, by the disapproval of all future legislation which will add to either the extension or perpetuation of the unsightly and dangerous electric services which encumber our streets."

Incandescent Lamp Patents.—The Consolidated Electric Light Company has filed an application in the United States Court against Mr. Edison and the Edison Company for an injunction restraining them from making, using or selling filaments for incandescent lamps of the nature described in the patent granted to the Consolidated Company, which is for an incandescent lamp having a conductor and a carbonised fibrous or textile material. By this action the litigation already pending becomes further complicated and involved, and it is rather difficult to tell when and what the end will be of all the various suits.

Incandescent Street Lighting.—A proposition has been made by the Edison Electric Illuminating Company, of Lawrence, Mass., to furnish that city with as many electric lamps as the number of oil and gas lamps now owned and operated by the city, and 25 additional lamps to be placed as directed, the entire care and expense of maintenance to be assumed by the company, which will furnish the current to all the lamps throughout the year during the usual hours of lighting, and to 100 of them the entire night. The poles, wires and other fixtures furnished by the company are to remain its property, and the city is to grant the right of use of such poles as are already set where the rights of others will not be interfered with. The expense to the city under this arrangement will be $650 per month, extra lamps, subsequently ordered, to be furnished *pro rata*.

Electric Lighting of Steamships.—The owners of the ss. *Burrumbeet* and *Coranganuto* having decided upon the introduction of the electric light, the work has been carried out by Messrs. J. D. F. Andrews & Co., of Woodside Electric Works, Glasgow, under the direction of Mr. McKay, superintendent for the owners. A horizontal double cylinder Tangye's engine, placed in the engine room, drives an Andrews patent Woodside dynamo at 425 revolutions per minute, which provides the current for the 160 lamps. This machine has been specially designed for ship use ; it can be taken to pieces with little labour and in confined places. Messrs. Andrews & Co. inform us that they have also fittted up a complete set of pneumatic bells in both ships.

Electric Light in South America.—During the past six months the Guatemala Electric Light Company has installed 300 arc lights in that city. This company, after an exhaustive investigation into the workings of the various systems of electric lighting both in Europe and the United States, adopted that of the Thomson-Houston International Electric Company, of Boston, Mass., U.S.A., and now have the largest installation of arc lights in South America.

The Incandescent Lamp Tests at Philadelphia.—Our namesake in New York questions very strongly the reliability of the tests recently carried out by a committee of the Franklin Institute as to the life of incandescent lamps, remarking that if those portions of the results already made public fairly represent the whole, the discriminating public can wait without impatience almost any length of time for the balance, or even hear without a sigh that they will not be made public at all. Our contemporary disclaims any desire to impute unworthy conduct or motives to the committee, but simply believes the results of the lamp tests to be unreliable and misleading, if not absolutely erroneous, worthless ; this, it says, may have come from inexperience of the members of the committee, incompleteness of the apparatus, or carelessness. We concur in the remark that it is somewhat strange that lamps which have been in use for years alongside of the Edison, without any marked difference in the duration of life, should be found so wanting as is charged in this Franklin Institute manifesto.

The Electric Light a Necessity. — The adjourned inquiry into the cause of the explosion at the Clifton Hall Colliery was resumed at Pendlebury on Wednesday. The principal witness was Mr. Dickinson, local inspector of mines, who attributed the explosion to the use of naked lights in the mine. He spoke in terms of satisfaction at the ventilation of the colliery, and said he knew that the proprietors believed the naked lights were safer than lamps.

Co-operative Telephony.—A writer in the *Manchester Guardian* describes a scheme which is on foot in that city to supplant the existing telephone company (the Lancashire and Cheshire) upon the expiration of its patent rights in 1890. He says that a committee has been formed in Manchester and Liverpool, which will issue the prospectus of the "Co-operative Telephone Association" in January, 1888. It is computed that 4,000 subscribers will immediately be obtained, and provision will be made for 5,000. Nearly all the Manchester subscribers to the Lancashire and Cheshire exchange are either buyers or sellers of cotton, and the assistance of most of these is anticipated. Something like an attempt to "boycott" the Lancashire and Cheshire company will then be made. £50,000 is to be the capital, and interest at the rate of 5 per cent. is to be paid thereon. We would remind these sanguine schemers that it is quite possible there may be a prolongation of the Bell patents, when the execution of their benevolent intentions will be unavoidably delayed.

Cheap Telephony in Sweden.—The following information, supplied by a Swedish gentleman, is published by a contemporary :—A mutual association to work the telephone has been formed in Gothenburg, Sweden, a town of 80,000 inhabitants. The charges are £2 15s. per annum for a radius of nine miles. There are now 600 subscribers and about 2,000 calls daily, and even at the low rate charged the institution has established a reserve fund. In the same town there is another company, the Bell Company, which has also 600 subscribers and about 3,000 calls daily ; the charge is £4 10s. per annum. Much smaller towns than Gothenburg have their mutual telephonic associations, which work well and cheaply. The State, as in this country, owns the telegraph, but no hindrance is offered to the telephones, and no royalties are charged.

Telephonic Charges.—An interesting correspondence is being carried on in the columns of the Manchester newspapers upon the present high telephone charges in that town. A correspondent in the *Guardian* for the 27th ult. points out that the public presently suffers from a double monopoly. The Government, he says, has a monopoly of the business, and the National Telephone Company of the instruments. In dealing with the telephone companies, he accuses the Post Office, which should have protected the interests of the public, of having actually betrayed them, and not only allowed the companies to charge what they pleased, but encouraged them to charge a high rate by taking 10 per cent.

The New Telephone Company.—A correspondent writes us respecting the operations of this company; we can give no further information than that which has already appeared in our columns.

Long Distance Telephony.—In consequence of certain unforeseen difficulties in connection with the Van Rysselberghe system the French Government still hesitates to adopt it generally. Some experiments by M. Tommasi have therefore been authorised. M. Tommasi has just proposed a solution which seems very promising from all points of view; he intends to diminish the current strength, and consequently the inductive effects. For this purpose he constructs an extremely sensitive relay, which he places near the telegraphic receiving instrument, and he can thus considerably reduce the number of elements composing the battery. Between Paris and Nantes, 425 kilometres, the battery usually employed for Morse or Hughes instruments consists of 70 elements. Upon this same line the Tommasi relay requires only five elements with the Morse and 10 with the Hughes. Over a distance of 615 kilometres, the same relay worked the Morse with six elements and the Hughes with 11, whilst these receivers ordinarily require 125 elements. The induction from the telegraphic current will thus be sufficiently reduced to allow clear telephonic transmission. This will shortly be verified, the Administration of telegraphs having placed at the disposal of M. Tommasi a public line from Paris to Rheims.

Music by Telephone.—Musical telephonic communication has been inaugurated between the *Vauxhall* at Brussels and one of the saloons of the tower on the left hand side of the entrance to the Antwerp Exhibition. This installation has been carried out by the *personnel* of the Compagnie Belge du Telephone Bell and of the *ateliers* Mourlon, according to the specification of M. Bertin. Ten persons can hear at once the music played by the orchestra at the *Vauxhall* and transmitted by the telegraph wires provided with the arrangements of Van Rysselberghe. The telegraphic service is carried on as usual. Arrangements are being made so that 35 persons may hear at the same time and by the same circuit. Numerous visitors were present at these experiments, which were perfectly successful, and they left astonished at hearing by telephone a concert conducted at a distance of more than 50 kilometres.

The Telegraph Conference.—The first meeting of the International Telegraph Conference at Berlin is fixed for the 10th proximo. Most of the European, and several extra-European States, have already notified their intention of sending delegates. Nearly all the large cable companies will also be represented.

Sixpenny Telegrams.—A Glasgow contemporary says that the local arrangements in connection with the sixpenny telegrams include the increase of the number of wires to all the principal towns, and the use of faster instruments to the less important stations. Should the sixpenny rate prove a success, our contemporary says, it is likely a threepenny rate for messages circulating between one part of the town and another, similar to that already in vogue in several of the Continental countries, will be introduced.

Exactitude in the Telegraph Department.—Says the *European Mail*:—A delicious example of Post Office exactitude has been brought to our notice. A surcharge was made upon a message containing news for publication, on the ground that the original charge was for 200 words, while the message really consisted of 201 words. The extra word involved an extra charge of several shillings, and it turned out that the "word" was simply an underline to the words "*status quo.*" Oddly enough, the underline was not actually transmitted, and yet the Post Office wanted to be paid for it!

The Telegraph in Asia.—The telegraph from Moulmein to Myawaddy, on the Siamese frontier, a distance of 75 miles, joining the Siamese line from Bangkok, will, it is believed, be finished before the coming dry season.

The Telegraph Acts Amendment Bill.—The London correspondent of the *Manchester Guardian* states that Lord John Manners is in great difficulty as to the Telegraph Bill. He will not give up free addresses, and the Department cannot afford sixpenny telegrams with free addresses. The new Postmaster-General, it is understood, contends that much might be done to abridge addresses by warning to the public, and by instructions tending in the direction of brevity. But this will not avail to carry the proposal unless he can obtain the sanction of the Treasury to the prospective loss; and there, it is said, he does not meet with support from Sir Stafford Northcote and Sir Henry Holland. At present, the chances are that Mr. Shaw-Lefevre's Bill will be dropped, because Lord John Manners was committed against the course proposed by the late Government.

Replying in the House of Commons on Tuesday night to Dr. Cameron, Lord John Manners said the Chancellor of the Exchequer stated on the previous night that it was the desire of the Government not to press forward any legislation of a contentious character. The object of the Postal Telegraphs Bill was to abolish free addresses on telegrams, and that was a question which had been very much contested both in the House and outside it. On that ground he was disposed to think that it would not be wise to proceed further with the measure during the present Session. During the past few days a fact bearing on the finance of the matter had been brought to his notice, and he thought it right to bring it before the House. It had been calculated by the officers of the department that if the estimates of the contemplated increase of business mentioned by the late Postmaster-General were realised, in the course of about four years there would be an additional outlay required on clerks, increased accommodation, and underground wires from London to the principal towns, of probably not less than £1,000,000. Under any circumstances, the scheme proposed by the Bill could not be brought into operation before the month of October. Therefore the Government considered that it would be inexpedient to proceed further with the measure this Session, and that it would be wise to remit the whole question to the next Parliament, which would have to find the very large sum of money he had just stated. Mr. Shaw-Lefevre asked whether it was the intention of the Goverment to withdraw the order for committee on the Bill that evening, and, if not, whether they would give an early day for the discussion of the matter. He thought there would be great dissatisfaction in the country if the Government intended to drop the Bill. He should like to have an opportunity of controverting the statements of the noble lord. In reply to Mr. Puleston, Lord John Manners stated that the estimate he had referred to was not new, but had been found by him when he went to the Post Office. Mr. Shaw-Lefevre: I should like to say that I had no knowledge of the estimate. Lord John Manners: I have given the facts as they have been given to me at the office.

International Telegraphs.—On Monday afternoon, the Duke of Richmond and Gordon received at the Board of Trade an influential deputation representing the principal cable companies, on the subject of the Bill now before Parliament to carry into effect the International Convention for the protection of submarine telegraph cables. The deputation included the Marquis of Tweeddale, Viscount Monck, Sir D. Gooch, M.P., Mr. J. Pender, M.P., Sir G. Elliot, Admiral Sir G. Richards, Mr. C. Burt, Mr. Bompas and Mr. Ford. Lord Tweeddale having stated the case of the deputation, the Duke of Richmond and Gordon said that the Bill was an attempt on the part of the British Government to carry out a convention which had been agreed to by the representatives of 26 States. The measure had already passed through the House of Commons without opposition, and had now reached the House of Lords. If the Government materially altered this Bill, they would be in the position of one State altering what had been agreed to by 25 other States. The reference of the Bill to a Select Committee for amendments at this late period of the Session would simply amount to getting rid of the Bill for this year. As at present advised, he thought he must go on with the Bill, but the representations which had been made would be duly considered.

Telegraph Revenue.—The receipts upon the telegraph service from April 1st to June 30th last amounted to £445,000 as against £440,000 in the corresponding period last year.

Cables to the Cape.—We note that the Cape Assembly has approved of the construction of a proposed alternative telegraph cable to connect that Colony with Europe.

Electric Tramcars.—There is much in Mr. Reckenzaun's paper, published in our issue of July 4th, to recommend the adoption of electrical motive power for the propulsion of tramcars. The author well deserves that success which we hope will soon be within his reach.

The Life of Secondary Batteries.—Notwithstanding Mr. F. Geere Howard's assumption that the life of secondary batteries is limited to six months or so, we know of at least one exhibitor in the Inventions Exhibition who is prepared to guarantee his plates for five years.

Hedges's Speed Gauge.—We learn on the best authority that a precisely similar arrangement to that of Mr. Killingworth Hedges, which we illustrated last week, was devised and experimentally tried more than a year ago by Mr. A. Sweetser, who abandoned the idea as not being, in his opinion, commercially successful. The instrument was primarily invented for showing the speed of locomotives.

Ohm's Law.—In our recent review of the "Primers of Electricity," we took occasion to call special attention to the last of the series, "Ohm's law." We trust that for the sake of young students of electrical science the errors made therein will be rectified before the publication of another edition.

Electric Light and Gunnery.—The 14-ton gun at the Inventions Exhibition was rendered more than usually attractive on the occasion of the Society of Arts Conversazoine on Friday last, the interior being illuminated by a special horizontal electric arc lamp, which has been adopted by Colonel Maitland, R.A., of the Royal Gun Factory, Woolwich, for examination purposes. The current was supplied from a "Holmes-Burke" primary battery, which, with one charge of fluid, gave sufficient energy to maintain the arc not only throughout Friday, but again on Saturday evening, when it also attracted large numbers of sightseers. Both lamp and battery are manufactured by Messrs. Johnson and Phillips.

Patents in America.—The fulfilment of Mr. Sellon's promise, made in our last week's issue, to throw some little light upon the proceedings of the American Patent Office as exemplified in his own case, will doubtless be looked forward to with no little interest, especially by would-be patentees. The small charge for obtaining protection for inventions in the United States is usually much more than counter-balanced by the vexatious, and, in many cases, frivolous, opposition so readily allowed, to combat which entails, upon residents in this country, very heavy expenses.

British Association Meeting.—After the lapse of twenty-six years the British Association will meet a second time in Aberdeen, on September 9th, under the presidency of Sir Lyon Playfair, K.C.B., M.P. The meeting will last until September 17th. Aberdeen is easily accessible from all parts of the Kingdom. From London it can be reached by rail by any of the leading routes in about 15 hours, and a line of excellent steamers runs twice a week between London and Aberdeen, with a passage of a little over 30 hours. The halls and lecture rooms of the University at Aberdeen, and the halls of the city and county authorities have been placed at the disposal of the executive committee, to be used as reception rooms and for the meetings of the various sections. For the general meetings, the Music Hall, capable of containing an audience of about 3,000, has been engaged. Two *conversaziones* will be held in the new Art Gallery and Gray's Art School adjoining, where will be exhibted a loan collection of paintings. The Queen has graciously granted permission for an excursion party to visit Balmoral, and special invitations have been received from various noblemen and gentlemen of the neighbourhood. There are many excellent hotels and lodging houses in the city, and a list of these, and other particulars, may be had of the hon. local secretaries, Messrs. J. W. Crombie, Angus Fraser, and G. Pirie, 123½, Union Street, Aberdeen.

Alexandra Palace International Exhibition.—The only item of an electrical character (apart from the lighting of the building) which we have been able to discover at this exhibition is a glass case of samples of the covered wires manufactured by the firm of Shaw and Connolly, Varley Street, Manchester. In addition to a great variety of specimens of fancy flexible cords for bell and telephone work, high conductivity (99 per cent.) copper wire, tinned wire, and special tapes and wires for armatures, the firm shows what it is capable of turning out in the way of larger work, such as electric light leads of all dimensions and submarine cables; this latter being a department of the business to which, we understand, special attention is given.

The Cost of Secondary Batteries.—One of our correspondents draws attention this week to the almost prohibitive prices charged for secondary batteries. Manufacturers would do well to take this matter to heart, the subject having previously been commented upon in our issue of May 9th of the present year.

An Electric "Front-Sight" for Firearms.—There is often a difficulty in getting an aim in the early morning or evening, on account of there not being light enough to enable the front sight of the rifle to be seen. The invention of Mr. Walter Winans, of Brighton, is designed to overcome this difficulty by means of a temporary front-sight, to be fixed to the rifle when the light is not good enough to see the ordinary fixed front-sight properly. This temporary front-sight consists, briefly, of a very small incandescent or glow lamp (something like a dentist's), covered with a metal shield. The shield has a small hole in it, through which the light shines, and this spot of light, being turned toward the shooter, is used as the "bead" of the front-sight in aiming, a small electric battery in the stock of the rifle generating the electricity for the lamp.

The Electro-Dynamometer.—The electro-dynamometer devised by Siemens is, after all, for universal application, the most reliable of current measurers; this has been recently shown most conclusively by M. Hospitalier.

Cardew's Voltmeter.—The apparatus invented by Captain P. Cardew for the measurement of differences of potential appears likely to be extensively employed; it seems to be the only practical instrument, for use with alternating current machines, upon which dependence can be placed.

Electrical Measuring Instruments.—M. Hospitalier, the energetic editor-in-chief of *L'Electricien*, is still doing good work in showing up the errors which may so readily be incurred by the indiscriminate use of electrical measuring instruments. A translation of a recent paper of his in our current issue may be perused with advantage.

Electricity in Hotels.—The Victoria Hotel, Manchester, which will be one of the largest in the city, is now almost completed. Thirty-two miles of copper wire have been laid down, connecting the electric bells and indicators with the press buttons in every room. Gas will be used in the bed rooms, and for the present in the larger rooms, but the latter are fitted to be lighted with electricity.

Scientific Experiments.—The *Daily Telegraph's* Paris correspondent states that some curious experiments were made on the decapitated head of Gagny (the murderer executed last week) fifteen minutes after its separation from the trunk. The blood of a dog was infused through the carotid artery, and by titillating the nerves the eyelids became contracted, and movements were visible in the lower jaw. Electric currents were applied to the nerves of the face, and caused motion. The trunk was then acted upon by the same forces. The nerves of the hand were visibly affected, and twenty minutes after execution the heart was made to beat. This organ was found to be clogged, owing, it is supposed, to the stoppage of the circulation a few moments before death.

Vyle's Lightning Conductors.—Messrs. Harrison, Cox-Walker & Co., of Darlington, have attached one of Vyle's patent easily-tested lightning conductors to the chimney shaft erected at the Grosvenor Gallery. Messrs. Mackenzie and Brougham, consulting engineers, have expressed their appreciation of the rapid and satisfactory manner in which the work was carried out.

The Daft Motor.—The first trial trip of the new Daft electric motor was made on June 16th on the line of the Union Railroad Company at Baltimore. It had rained during the previous night and the track was not in favourable condition, being in places covered with dirt; this caused some stoppages, but altogether the trial was considered successful.

Underground Wire Laws in America.—The passing of the Bill of Senator Daly respecting overhead wires in New York and Brooklyn into law has been followed by the issue from the "Electrical Department" at Philadelphia of a communication notifying the telegraph, telephone, electric light and railroad companies that they must comply with an Act of City Councils which states that all wires in the city must be placed underground or removed by January 1st, 1886. Respecting this matter the *Electrical World* says:—Mr. Walker is, we believe, a good electrician, and therefore knows that such an order is a roaring farce. The city could not even get its own wires underground in the time mentioned, not to speak of the thousands of miles of wire operated by the various telegraph, telephone, electric light and railroad companies. To cut the wires would be municipal suicide, as Chicago recently demonstrated, since that would preclude any possibility of forwarding a fire alarm or a call for an ambulance; it would paralyse the police system just inaugurated there, and cause a riot among the brokers and merchants thus cut off from the outer mercantile world. The telegraph and telephone companies can as well afford to let Philadelphia alone and go all around, outside of her Chinese wall, as she can to deliberately cut herself off from communication with the world at large. The same remarks may apply also to this city, Governor Hill having signed the Bill requiring all wires in this city and Brooklyn to be put underground before the 1st of next November. In both cases the date is set close enough, in view of the physical difficulties in the way of carrying out such preposterous laws, to furnish a sufficient excuse to defeat the object. Of course, the law appoints a commission to see its edict carried into effect, but it may as well appoint a commission to see that the traditional camel gets through the eye of the infinitesimal needle.

Regarding the New York and Brooklyn statute, the Mayor of Brooklyn has appointed the three Commissioners to carry out the provisions of the Act in that city. These are Mr. George W. Plympton, a Professor of the Polytechnic Institute and editor of an electrical journal; Mr. Rossiter W. Raymond, whose name is also connected with scientific research; and Mr. John Reynolds, a lawyer. The salary of each is $3,000 a year, and they will hold office until November, 1887. These appointments appear to give general satisfaction, and the naming of the New York Commissioners is anxiously awaited. According to the *New York Herald*, the representatives of the Western Union Telegraph Company make no secret of their intention to obstruct the execution of the law to the extent of their ability; and as to the first obstructive step, one of them remarked significantly to a reporter, that it may depend upon the characters of the commissioners. "We want to know," said this gentleman, "with whom we have to deal." "Just so," remarks the *Herald*; "'deal' is a suggestive word."

New use for an Insulator.—We learn that experiments are to be made at Portsmouth under Admiralty directions; these are expected to give interesting results. Targets coated with India rubber sheets are to be fixed on to the side of armour-clad resistance; these targets will be subjected to progressive gunnery tests, commencing with a 6-pounder, qnick firing gun, and increasing, if possible, up to a 6-inch 9-ton breechloader. Should the trials be attended with the success anticipated, the arming of men-of-war will be almost revolutionised. Experiments somewhat similar to these, although on a smaller scale, were tried at Cherbourg some six years ago by the French Government; a torpedo boat was coated outside with sheets of India rubber by the Silvertown Company. On this boat being subjected to the rapid fire of a machine-gun, the results obtained proved the advantages of the system; the bullets passing through the India rubber, which closed after their passage, thus preventing the entrance of water, although the steel plates of the hull to which the India rubber was attached showed large ragged openings. The objections to the adoption of this system were such as would only apply to small vessels, such as the torpedo-launch experimented on; the heat from the boilers inside, in this case, preventing the perfect adhesion of the India rubber in their neighbourhood.

An Electropathic Home at Plymouth.—The value of electricity for medical purposes has been over and over again exemplified, and there is at present in existence at Plymouth an Electropathic Home, where patients are treated by this means. It is stated that by the treatment which is afforded at this establishment, cases of chronic rheumatism, and even of partial paralysis, have been cured. Tickets are distributed among subscribers to the institution, so that sufferers from the maladies mentioned, who are too poor to obtain adequate medical assistance, can gain free admission.

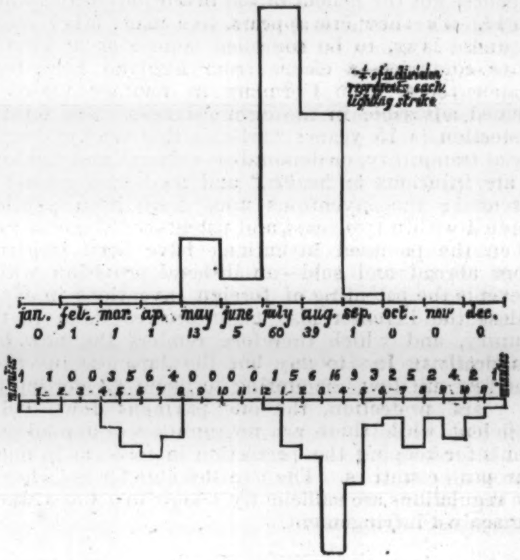
"Another Martyr to Science."—Under this heading our chatty little contemporary, the *Monthly Correspondent*, publishes the following capital lines upon an incident which befell a cat, as related in the REVIEW for May 30th :—

On Yankee soil, some little while ago,
A wheel was used to drive a dynamo,
Which for the public benefit put down,
Furnished electric lighting to the town.
Of course, you've seen in these inventive times
The apparatus that suggests my rhymes,
And so particulars thereof possess
Of which the bard has not the faintest guess.
This wheel by night revolved with might and main,
And in the daytime sought repose again.
'Twas "in the gloaming"—just upon the hour
When started into life this motive power ;
The word was giv'n—its rest was at an end—
And slowly, see, the heavy spokes ascend.
When someone cried, "Why, bless my eyes, what's that?
Great Julius Cæsar, if it ain't a cat!"
Too true ; Grimalkin's thoughtless enterprise,
Resting upon a spoke to close her eyes,
Reaps its reward, and, with a sick'ning whirl,
The huge steel bars and felloe upward hurl.
Like famed John Gilpin, clinging for dear life
Sans coat, wig, bottles, in the equine strife,
Like Judson's dyes, or like proverbial death
Gripping the nigger's corpse with icy breath,
Like the sweet smile upon a dentist's face
Turned on a patient—Puss maintains her place.
Teeth, claws, and eyelids, driven to the steel,
She tighter clings, and faster whirls the wheel.
Pois'd for a second's thousandth at the top,
She swings below and all but has to drop ;
Now standing on her head, now upward flung,
With glazing eyeballs and protruding tongue,
Now twisted upwards, writhing in mid-air,
Her varied pose would make a Blondin stare!
The engineer, who worked the dynamo,
Refused to stop his wheel or pussy's woe :—
"What! break the current, lighting just begun?
"Cat? cat's own fault for sleeping ; let her run!"
So till the morning blushed into the blue,
Like rash Ixion round and round she flew,
And when the respite came, tho' trebly bless'd,
And the fierce motor too was bid to rest,
Light, sound, and reason scattered anywhere,
The martyr dropped like an o'er-ripened pear.
Moral.—A maxim I may well repeat :—
The steady head may help the rashest feat,
While pussy's bard this wise conclusion draws :
Her life was lengthened *through the saving clause*!
Wheels *within* Wheels.
Madeira.

Overhead Wires at Brighton.—At the last meeting of the Brighton Town Council the Works Committee reported that at their meeting on 19th June a letter was read from the secretary of the General Post Office, requesting permission to erect an overhead wire from the Parochial Offices, Church Street, to existing underground wires in the Grand Parade. It was resolved : "That in compliance with the application of the secretary to the General Post Office, and subject to the conditions of the consent given by the Corporation on the 7th May last to the erection of a telephone line in the Borough, the Corporation, so far as they lawfully can, hereby consent to the erection by the Postmaster-General of a line of telephone from the Parochial Offices, Church Street, to the Brighton Workhouse, Elm Grove, and to the placing by him of wires for that purpose over Church Street to the Grand Parade, from whence the wires are to be carried underground to the workhouse." The action of the committee was confirmed.

Freeman's Transmitter.—In our other columns will be found a description of this apparatus, compiled from a specification which a correspondent in the United States has kindly forwarded to us. As we briefly notified last week, we think Mr. Freeman is mistaken with regard to the action of the transmitter, although the results obtained therefrom may be good. We are, moreover, under the impression that a similar arrangement had been proposed by Dr. Herz so long ago as the year 1881, and, in addition to this, the same method of working may be found in a patent of J. Rapieff's, dated March 3rd, 1882.

Lightning Statistics. — The following diagrams, extracted from the *Bulletin de la Societe Belge d'Electriciens*, are interesting as showing the relative frequency of thunderstorms (in Belgium) causing damage during the different months of the year, and also during the different hours of the day. It will be observed (as might be expected) that the curves reach their maximum value during the hottest months, and during the hottest hours of the day.



Something like an Accumulator.—We are informed that the *painted wood* plates in the large secondary battery to which we drew attention last week, are employed, not for the production of electrical energy, as some might be led to suppose from the fact of the paint containing oxide of lead, but because the strength of the floor upon which this apparatus stands is insufficient for the weight of the metal which would be used in actual practice. *Quien Sabe?*

Banquet to the New United States Minister.—On Saturday evening last week a banquet was given to Mr. Phelps, the new United States Minister, by Mr. Cyrus W. Field at the Buckingham Palace Hotel. Among those present were the Duke of Argyll, Lord North, Lord Houghton, Mr. George F. Edmunds (United States Senator), Mr. John Bright, M.P., Sir Thomas Fowell Buxton, Sir Daniel Gooch, M.P., Sir George Elliot, M.P., Professor Sir William Thomson, Sir James Anderson, Mr. Henry M. Stanley, Mr. Waller (American Consul-General), Dr. Russell Reynolds, Mr. Potter, M.P., Archdeacon Farrar, Mr. P. Hugh, Mr. Henry White (United States Legation), Mr. W. H. Preece, F.R.S., and Dr. Henry D. Noyes (New York).

The Illuminated Fountains at the Inventions Exhibition.—On Monday evening their Royal Highnesses the Prince and Princess of Wales and a distinguished party proceeded to Sir Francis Bolton's aerial tower, whence they were able to command a magnificent view of the illuminated gardens and fountains. The Princess set in motion and "coloured" with prismatic rays more than one of the radiant fountains which so pleased the assembled crowd. Their Royal Highnesses expressed in the most cordial terms to Sir Francis their delight and surprise at the simplicity of the mechanism, the results of which were so charming. After the exhibition was closed the experiments were continued, much to the gratification of the Royal party.

The Jablochkoff Battery. — If a correspondent, "Sceptic," will forward us his name and address we will insert his letter on this subject. It is against our practice to publish anonymous communications.

A Japanese Patent Law.—Determined upon progress, the Japanese have at length passed a patent law. It was not without much cogitation that this was brought about, for, as in America with respect to copyright, it was argued that with no patent protection the Japanese got the benefit of the inventions of the whole world. The new law appears, like many other recent Japanese laws, to be compiled from similar laws of other countries—a clause from England here, from France there, from Germany in another place, as seemed advisable in the circumstances. The term of protection is 15 years; "articles that tend to disturb social tranquility, or demoralise customs and fashions, or are injurious to health," and medicines cannot be patented; the inventions must have been publicly applied within two years, and patents will become void when the patented inventions have been imported from abroad and sold—an illiberal provision which prevents the patenting of foreign inventions in Japan unless the inventor also manufactures them in the country, and which therefore renders the new law practically useless to any but the Japanese inventor. The fees are low, amounting to about £3 sterling for 15 years' protection, the one payment down being sufficient, while there are no annuities or annual payments for keeping the protection in force, as in many European countries. The punishments for breaches of the regulations are sufficiently severe to act as a warning against infringement.

That's how it's Done!—Mr. Magnus Volk has just published a little illustrated pamphlet intended to answer, in a simple and popular manner, the numerous questions continually put by the travelling public on his electric railway respecting the propulsion of the cars. A non-technical reader will be enabled, by a perusal of this simple exposition of the details of the Brighton electrical railway, to easily grasp the principles involved in its construction and operation. It is not too much to say that many, many thousands of the general public have become more or less interested in applications of electricity through Mr. Volk's successful enterprise on Brighton beach.

The late Prof. Fleeming Jenkin.—In the last number of the *Fortnightly Review* we notice amongst the contents:—"Fleeming Jenkin—In Memoriam," by Prof. Sidney Colvin.

The Society of Arts.—On the evening of Friday last week was held at the Inventions Exhibition the *conversazione* of the Society of Arts, under the presidency of Sir Frederick Abel, F.R.S. The gathering, like that of the Institution of Civil Engineers a few weeks previously, was a most successful one; several thousands of members and their friends being enabled to pass a thoroughly enjoyable evening. The weather was all that could be wished, and the attractions were of such a varied character as to satisfy the tastes of all; although, as in the case of the Civil Engineers, the exhibition itself was practically closed, it having previously been politely intimated to the exhibitors that their presence was not an absolute necessity on such occasions.

Overhead Wires in America.—Some telephone employés were caught stringing wire at Chicago the other day and were fined $100 each. A New York contemporary says:—"If the electric companies are tempted, while ostensibly engaged in the repair of wires already up, to sneak additional wires, it is the city's fault, and due entirely to the restriction placed upon the companies in this respect." A scheme, however, is mentioned which, if carried through, would result in an arrangement by which the electric companies would secure the use of conduits wherever required, the Conduit Company dealing with the city officials for all. As the matter now stands, says our contemporary, the companies are forbidden to string wires overhead, and are required to put them underground. But to do this latter they must have a permit from the city, and to get this permit is something which no man acquainted with the difficulties in his way would have the hardihood to undertake single handed.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Hammond Electric Light and Power Supply Company, Limited.—An order of the Chancery Division of the High Court of Justice, dated 20th ult., and filed on the 3rd inst., directs the voluntary winding up of the company, subject to the supervision of the Court, and orders that Mr. William Theobald be discharged from his office of provisional official liquidator. It is also ordered that the costs of the petitioner, creditors and the contributories supporting the petition, be taxed and paid out of the assets of the company; but it is provided that in such taxation only one set of costs is to be allowed to the creditors, and one set of costs to the said contributories.

Hastings and St. Leonard's-on-Sea Electric Light Company, Limited.—The annual return of this company, made up to the 30th ult., was filed on the 1st inst. The nominal capital is £50,000 in £10 shares. 850 shares have been allotted, and of these, 167 shares have been issued as fully paid up to the Hammond Electric Light and Power Supply Company, Limited. Upon 683 shares the full amount has been called up, the calls paid amounting to £6,785, leaving £45 unpaid. As compared with last year's return, the paid up capital shows an increase of £127 10s.

Lancashire and Yorkshire Electric Lighting Company, Limited.—The annual return of this company, made up to the 17th ult., was filed on the 2nd inst. The nominal capital is £100,000 in £5 shares. 127 shares have been taken up, and £2 10s. has been called; the calls paid amounting to £315, and unpaid to £2 10s. Registered office, 5, St. James's Square, Manchester.

Electric Apparatus Company, Limited.—The annual return of this company, made up the 11th ult., was filed on the 2nd inst. The nominal capital is £12,000 in £10 shares. 600 shares have been taken up, and of these, 300 have been issued as vendors' shares fully paid up. Upon the remaining 300 shares £7 10s. per share has been paid up. Office, 60, Queen Victoria Street.

LEGAL.

The Universal Electric Company. Limited. — On Wednesday week, in the First Division of the Court of Session, Edinburgh, a note was presented by Thomas Wilson and Alex. Murray, liquidators of the Universal Electric Company, Limited, Baltic Street, Glasgow, asking sanction to two compromises, one with a creditor and another with a debtor of the company, and for dissolution of the company. Mr. Shaw asked that their Lordships should hear counsel *in camera* upon the proposal to compromise, and that the proposal to dissolve the company should be advertised. He explained that the resolution to wind-up was adopted in January, 1883. In July sanction was given to a number of compromises, and the liquidators were now of opinion that the liquidation should not come to an end. The abstract of their accounts showed that the total amount realised by them was £3,080. They had paid the preference claims—amounting to £800—in full, and 3s. 4d. per £ to ordinary creditors. A balance of £820 remained to be distributed, which would give a dividend to ordinary creditors of nearly 8s. per £. Their Lordships agreed to both motions.

CITY NOTES, REPORTS, MEETINGS, &c.

Eastern Telegraph Company, Limited.

The directors submit the report following for the six months ended 31st March, 1885:—

The revenue for the period amounted to £371,682 19s. 11d., from which are deducted £91,599 14s. 2d. for the ordinary expenses, and £44,815 4s. 7d. for expenditure relating to repairs and renewals of cables, &c., during the half year. After providing £2,775 16s. 2d. for income tax, there remains a balance of £232,492 5s., to which is added £30,364 5s. 6d. brought from the preceding half year, making a total available balance of £262,856 10s. 6d.

From this balance there has been paid:—Interest on debentures and debenture stock, £27,370 13s. 9d.; dividend on preference shares, £20,384 13s. 7d.; an interim dividend of 1¼ per cent. on the ordinary shares, £47,500; total, £95,255 7s. 4d.; leaving a balance of £167,601 3s. 2d., from which £100,000 has been carried to general reserve.

The directors now recommend the declaration of a final dividend for the year ended 31st March, 1885, of 2s. 6d. per share, and a bonus of 1s. per share, amounting to £66,500, both payable on the 16th instant, making, with the three previous payments on account, a total distribution of 12s. per share, or 6 per cent. for the year on the ordinary shares. The balance of £1,101 3s. 2d. shown at the foot of the revenue account is proposed to be carried forward to the next half year.

The revenue includes £11,700 dividend for the half year upon the company's shares in the Eastern and South African Telegraph Company. Also £2,600 net receipts for the same period on the shares of the Black Sea Telegraph Company belonging to this company.

The directors of the Eastern and South African Telegraph Company have resolved to duplicate their cable between Zanzibar and Mozambique. This section has been interrupted during the spring months of each year since the cable was laid, causing loss of traffic to the companies, and great inconvenience to the Imperial and Colonial Governments and the mercantile community. The duplication will be charged to the reserve fund of that company.

An arrangement has been entered into by the company with the Turkish and Greek Governments for the laying of a duplicate cable between Syra and the Island of Chios, 100 miles.

The several sections of the company's cables, and the land lines in connection therewith, are in good working order, with the exception of the 1870 Aden-Bombay cable, which is now under repair.

The company's two cables between Aden and Bombay were both interrupted on the 3rd June. One of the cables was repaired on the 27th June, and the communication by the other line can be restored with one or two calm days. The joint purse agreement with the Indo-European Telegraph Company prevented any serious loss of revenue.

The steamship *Electra*, referred to in the last report, has proved a valuable addition to the company's list of repairing ships, having already effected four important repairs. The cost of the ship has been charged to capital account.

To meet the further requirements of the service it has been found necessary to build another steamship, larger than the *Electra*, with twin screws, and the directors have entrusted the work to Messrs. R. Napier and Sons, the buiders of the *Electra*.

The directors have purchased on satisfactory terms the buildings at Alexandria and Port Said, previously rented by the company, as offices and quarters for the staff.

British Spiral Telephone Wire Syndicate, Limited.

Mr. Justice Chitty has made an Order continuing voluntary winding-up under the supervision of the Court. Mr. W. Downie, 28, Southampton Buildings, Chancery Lane, has been appointed liquidator.

British Insulite Company. Limited.—A resolution has been passed for the voluntary winding-up of this company and the appointment of Mr. S. L. Price, of 44, Gresham Street. E.C., as liquidator.

TRAFFIC RECEIPTS.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 30th June, are £2,876, as compared with £3,131 in the corresponding period of 1884. The March receipts, estimated at £6,763, realised £6,875.

The Great Northern Telegraph Company. The receipts for June, 1885, £24,840; from January 1st to June 30th, 1885, £142,840; for the corresponding months of 1884, £129,520; and of 1883, £123,480.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of June were £1,333, against £1,336 in the corresponding period of last year.

The West Coast of America Telegraph Company, Limited. The gross earnings for the month ending June 30th were £4,200.

PROCEEDINGS OF SOCIETIES.

Physical Society, June 27th, 1885.

Prof. GUTHRIE, President, in the Chair.

Dr. Ramsay, Messrs. T. Hands, F. W. Sanderson, W. A. Shenstone and F. H. Nalder were elected members of the society. The following communications were read:—

"On the Specific Refraction and Dispersion of the Alums," by Dr. J. H. GLADSTONE. The refraction, dispersion, and specific gravity of nineteen different alums in the crystalling form were published by M. Charles Soret, of Geneva, in the *Comptes Rendus* for last November, These, together with some additional data from Soret, Topsöe, and Christiansen, were employed by the author for comparison with certain experimental results of his own and of Kannonikof. In this way additional proof was obtained that a salt has the same specific refraction whether it be crystallised or dissolved, and that the refraction equivalent of a compound body is the sum of the refraction equivalents of its components. The refraction equivalents of the alkalies in these alums are in the following ascending order: sodium, potassium, ammonium, subidium, methylamine, calsium, and thallium; and of the other metals, aluminium, chromium and iron. This is in accordance with what was previously known, but Soret's observations do not afford the means of determining the equivalents more accurately than before. The refraction equivalents of indium and gallium were determined for the first time, giving respectively 17·4 and 14·8. The specific dispersion of the same compounds, measured by the difference between the specific refractions for the lines A and G was also examined. The differences of dispersion are much greater comparatively than the differences of refraction. The order was also determined, but not the actual dispersion equivalents of the different elements.

"On a Form of Standard Daniell Cell and its Application for Measuring Large Currents," by Dr. J. A. FLEMING. The author first referred to the careful and thorough investigation of the circumstances affecting the electromotive force of Daniell's and allied cells by Dr. Alder Wright. He then described a form of all that had been found most convenient and reliable in practice. It consists af a U tube, in the two limbs of which are the two solutions of sulphate of copper and sulphate of zinc of the same specific gravity. Electrodes consisting of freshly electro-deposited copper and pure zinc that has been twice distilled dip into the two limbs. The E.M.F. of this cell is 1·102 and the variation of E.M.F. with temperature is practically nil.

"On the Phenomenon of Molecular Radiation in Incandescent Lamps," by Dr. J. A. FLEMING. Some years ago Dr. Fleming had called attention to a phenomenon in incandescent lamps very analogous to that of discharge in high vacua observed by Mr. Crookes. The inner surface of the lamp glass was sometimes found to be coated with a deposit of carbon, with the exception of a clear line marking the intersection of the glass with the plane of the loop, and being, in fact, a shadow of the loop, apparently caused by an emission of matter from the terminals. Dr. Fleming has since found how to produce this appearance at pleasure by passing a very strong current momentarily through a lamp, and has succeeded in obtaining similar deposits of various metals that had been used as terminals. These deposits show colours by transmitted light, and as a general result the author concludes that red metals, such as gold and copper, appear green by transmitted light, whereas white metals, like silver and platinum, appear brown, a conclusion which, however, was challenged by Capt. Abney in the discussion ensuing.

"On Problems in Networks of Conductors," by Dr. J. A. FLEMING.

"Lecture Experiments on Colour Mixtures," by Capt. ABNEY. The apparatus employed by Capt. Abney is a modification of Maxwell's colour box. The spectrum instead of being formed upon a screen is received upon a convex lens which forms an image of the face of the prism upon a screen. If all the light from the prism falls upon the lens this image is colourless, but by interposing a screen with a slit in the spectrum close to the lens, so as only to allow light of a given colour to fall on the lens, the image appears coloured with that light. By using two or more slits different lights may be mixed in any required proportions.

"On stream-lines of moving vortex-rings," by Prof. O. J. LODGE. The communication described a method of drawing vortex stream lines, consisting in superposing uniform motion represented by a series of parallel lines upon the lines of a stationary vortex, as given by Sir W. Thomson in his memoir on vortex motion, and joining up the corners of the quadrangles so formed. This operation is very simple, and by its application a number of the more remarkable properties of vortex rings may be obtained; the general analytical investigation of which involves mathematical methods of the highest order. Drawings were exhibited showing the nature and behaviour of a single vortex ring moving with different velocities, a vortex ring approaching a large distant obstacle, the chase of two unequal rings, and many other cases.

"On the thermo-electric position of carbon," by Mr. J. BUCHANAN. It having been observed that the carbon filaments of incandescent lamps usually gave way at the negative end, experiments were instituted to find if the destruction could be due to the "Peltier effect" causing a local generation of heat. Observations on a platinum-carbon thermo-couple showed that a generation of heat would result from a current passing from carbon to platinum, but the effect was too small to account for the observed phenomenon. It was found that a couple of carbon-iron rose considerably in E.M.F. by maintaining the hot joint for some time at 250° C.

"On some further experiments with sulphur cells," by Mr. Shelford Bidwell. The paper contains: (1) A description of a class of cells which give a constant voltaic current, the electrolyte consisting of a solid metallic sulphide. (2) An explanation of the unilateral conductivity exhibited by selenium and by sulphur cells; and (3) A description of a cell which gives, as the result of passing a current through it, a current in the same direction as the primary current.

NEW PATENTS—1885.

7659. "Mariners' compass." H. Job. Dated June 24.

7695. "Galvanic batteries." L. A. Groth. (Communicated by T. Erhard.) Dated June 24.

7700. "Electro-magnets and induction coils." C. D. Abel. (Communicated by M. Lahaussois.) Dated June 24.

7733. "Electrical batteries." H. C. B. Shalders, A. J. Thorman. Dated June 25.

7761. "Dynamo-electric machines." P. Higgs. Dated June 25.

7768. "Electro-magnetic marine governer." G. A. Smith. Dated June 26.

7787. "Manufacture of covered or insulated wires, and apparatus therefor." A. J. Boult. (Communicated by J. D. Thomas. Dated June 26.

7799. "Telegraphy and telephony." C. Langdon-Davies. Dated June 26.

7803. "Means and apparatus for generating electricity. H. Lane. Dated June 26.

7839. "Filaments or carbons for incandescent electric lamps." A. P. Price. Dated June 27.

7869. "Incandescence electric lamps." H. Watt. (Communicated by E. Weston.) Dated June 29.

7873. "Electric generators." B. A. Raworth. Dated June 29.

7881. "Electric clocks." A. M. Clark. (Communicated by A. Sauer.) Dated June 29.

8036. "Electric telegraphs." H. C. Mance. Dated July 2. *(Complete.)*

8049. "Feed-regulating mechanism of electric arc lamps." C. F. Cooke, T. Robinson. Dated July 2.

8076. "Electrical conducting material." C. S. Bradley. Dated February 24. (2463, 1885.)

8122. "Electro-telephonic transmitters." A. A. Campbell-Swinton. Dated July 4.

8128. "Switch for electric circuits." E. Zeller. Dated July 4.

8140. "Acoustic telephone lines." A. Le N. Foster. Dated July 4.

8154. "Course and position finders and compass correctors for sea use." A. W. G. Ross. Dated July 6.

8171. "Apparatus for causing an electrical circuit to be closed or opened by passage of a railway train." W. Buck. Dated July 6.

8172. "Telegraph instruments on board steamers, &c." J. Childs. Dated July 6.

8196. "Electrical accumulators or secondary batteries." W. R. Lake. (Communicated by J. B. Rognetta and N. de Kabath.) Dated July 6.

8197. "Electric tell-tale apparatus for cornmill feed spouting on roller mills and bins." A. Johnson, G. G. Rhodes. Dated July 7.

8222. "Constructing metallic specula for telescopes and other reflecting instruments, hydro-electrically coating them with unalterable metals to be silver, palladium, &c." V. Sàfàrik. Dated July 7.

8228. "Voltaic batteries." H. J. Harris. Dated July 7.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1884.

8707. "Improvements in the manufacture of electrical lamp supports and fittings." T. T. Smith. Dated June 7. 6d. Relates to improvements in the manufacture of supports and fittings for electrical lamps, the object in view being to facilitate the placing of the lamps in the most convenient positions, and to enable the electric current to be completely controlled without twisting or bending the lamp supports in turning the current on or off. The invention also relates to certain improvements whereby the position of the lamp shade or reflector can be readily varied to suit different patterns of lamp, and for enabling the lamp stem or branches to be bent without injury to the flexible cord conveying the current.

8796. "Improvements in telephone circuits." S. P. Thompson and P. Jolin. Dated June 10. 6d. Consists in winding the electro-magnet with a double or divided coil, so arranged that the magnetising current in traversing the two branches or parts or divisions of the coil, produces no magnetic effect until the current in one branch or division of the coil is stopped by the complete rupture, or by the partial opening, of that branch or division. To accomplish this end it must be arranged that the windings of the two branches or divisions of the coil shall be so wound around the core, and so connected together and to the circuit, that the currents shall circulate around the core in opposite directions. When such a method of winding is applied, the inventors find that great improvement results in the working of induction coils, and in telephonic circuits.

9801. "Improved apparatus for measuring and recording electrical energy." F. Walker. Dated July 5. 6d. Consists of a cylinder driven by suitable clockwork, having a sheet of paper wrapped tightly round its outer surface. Two solenoids, one wound with thick wire, through which the whole current passes, and the other with fine wire of high resistance, in shunt. Each of these are fitted with an iron core, held in position by means of springs. So, when a current is passing through the low resistance solenoid, the core is drawn into it against the tension of the spring, in a degree proportional to the current. The core of the other solenoid is depressed in proportion to the electromotive force. Two arms are attached to each of these cores, carrying pencils, which, pressing upon the paper on the revolving cylinder, describes two curves, the sum of which at any period represents the electrical work done in the circuit. The paper upon the revolving cylinder is ruled vertically, the space between each line being traversed within an hour or half hour, and a proper scale being provided for each spring, so that the ordinates may be read off in volts and ampères, when the paper is removed from the cylinder and laid flat.

10505. "Improvements in telephony." J. G. Lorrain. Dated July 23. 6d. The transmitter may consist of a condenser or accumulator formed of two plates or masses of metal or other suitable material insulated from one another by a stratum of air or a layer or layers of varnish or of paper, or other suitable material. One of these plates or masses, hereinafter called the back plate, may be connected to the line going to the receiving instrument. The other plate or mass, hereinafter called the movable plate, may be connected to earth. One of the plates or masses, preferably the back plate, may be charged with electricity by any suitable means, for example, by a dry pile or by a rod formed of two dissimilar metals soldered together, or by a charge from a proof plane or otherwise. The receiver consists of an apparatus resembling in principle what is known as a "gold leaf electroscope." In its simplest form this consists of two sheets or strips of metal or other suitable material, joined together at one edge. When electrified these sheets or strips repel one another. The greater the charge of electricity the greater the repulsion between them, the less the charge the less the repulsion.

10511. "Improvements in and relating to electro-magnetic musical instruments." R. K. Boyle. Dated July 23. 6d. Comprises an improved method of producing musical sounds by the mutual action of an electric current and a magnetic field.

10530. "Safety fuses for electric circuits." Sir W. Thomson and J. T. Bottomley. Dated July 24. 6d. The object of this invention is in the first place to secure that the current shall be stopped by the action of the safety fuse, in as short time as possible after it has surpassed the greatest permissible degree, and that the amount of energy consumed in the permanent use of the fuse shall be as small as possible. For the substance in which the heat which melts the fusible conductor is generated, the inventors prefer silver or high-conductivity copper, because the rate at which temperature commences to rise in a conductor, on the commencement or sudden augmentation of a current through it, is inversely proportional to the product of the electric resistance into the specific heat, and because either of these metals is more suitable to give definite and constant results, and is also more convenient for making the connections required to put it into circuit, than the lead or the soft fusible alloys which have been most frequently used hitherto for safety fuses. When the permanent current is large enough, for example, when it is more than 8 or 10 ampères, the inventors use a copper wire in two parts, and united by an easily fusible solder at its middle. To secure that the contact shall be broken when the solder is melted, they make the end contacts in such a manner that the parts on the two sides of the soldered middle interface shall be pulled asunder when the solder melts. A form of fuse embodying the features hereinbefore set forth is represented in figs. 1, 2, 3 and 4, of which fig. 1 is a front elevation, fig. 2 a side elevation, fig. 3 a back elevation, and fig. 4 a plan. The fuse wire, *a*, which is represented at figs. 1 and 2, consists of two straight portions of wire connected together in line by a fusible metal soldering, *b*. Each end of the fuse wire, *a*, so formed is fitted with a comparatively heavy link, *c*, of copper or other metal of good conductivity. The peg, *d*, with which the upper link, *c*, of the fuse wire is in contact, is fixed and is in metallic connection with one side of the cut or break in the electric main provided for the insertion of the fuse. The peg, *e*, with which the lower link, *c*, of the fuse wire is in contact, is formed by the projecting arm of the spiral spring, *f*, which is in metallic connection with the other side of the cut or break in the electric main. The two pegs, *d* and *e*, are approximately in the same vertical plane, and have the upper and lower surfaces respectively slightly concave (as represented more particularly at fig. 2) so as to prevent the links, *c*, of the fuse wire, *a*, from slipping off the said pegs by reason of any vibration in the support to which the fuse is fixed. The drawing indicates by dotted lines at fig. 1 the position taken by the projecting arm of the spiral spring, *f*, when there is no fuse wire in the circuit, hence, by virtue of the resilience of the said spring, *f*, the peg, *e*, exerts on the fuse wire, *a*, placed in the circuit, a pull acting in the direction of the axis of the wire. By virtue of this pull the two portions of the fuse wire, *a*, are pulled asunder and the circuit broken when the current increases beyond the normal amount, and has thereby melted the fusible soldering, *b*. A portion of the fuse wire, *a*, so detached is represented in dotted lines at fig. 1. The two screw terminals, *g*, at the back of the fuse box, *h*, are placed in good electric connection with the two ends of the cut or break in the electric main. To place a fuse wire, *a*, in the electric circuit, all that is necessary is to hook one of the links, *c*, on the peg, *d*, press upwards the projecting arm forming the peg, *e*, and hook the other link, *c*, of the fuse wire, *a*, upon it.

FIG. 1.

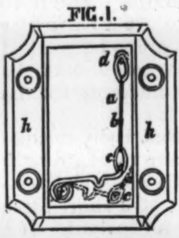


FIG. 2

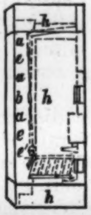


FIG. 3

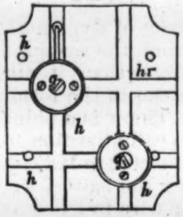
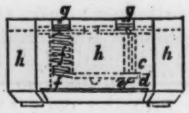


FIG. 4.



10536. "Improvements in the method of depolarising electric batteries." A. C. HENDERSON. (Communicated from abroad by E. Bazin, of Paris). Dated July 24. 6d. The feature of novelty in this invention consists in mechanically moving the zinc and carbon elements of electric batteries, and particularly in imparting to them a rotary motion; the elements in this case are in the form of circular discs, the object of such arrangement being to destroy or prevent the formation of gaseous globules of hydrogen which attaching themselves to the elements produce polarisation of the battery.

CORRESPONDENCE.

Underground Wires in America.

In your issue of June 17th there is a report of Geo. A. Hamilton, electrician of the Western Union Telegraph Company, in which he states that out of nine attempts to lay underground wires in New York, all of which were total or partial failures, eight of these cables were insulated with gutta percha, and one was of the Brooks system. Nine successive failures would leave European electrical engineers to infer that there was gross incompetence in connection with that work, but I beg to assure you that is not the case. That statement was made to be read by the lawyers and lobbyists before legislatures and town councils, who have been agitating the matter of compelling the company to bury its wires in cities. It has also been the rounds of all the electrical journals, large and small, and in every other paper that could be induced to publish it. Mr. Hamilton refers to the Brooks cable as follows:—"A 30 conductor Brooks cable was laid between Newark and Jersey City suburbs in 1880. The wires failed rapidly when put in service. This cable was afterwards repaired, part of the route changed, and considerable new cable added or substituted for defective portions in 1882. It saw scarcely a year's service, however, and none of the conductors are now in use. The experiments with this cable were made at an expense of more than $20,000." On the 24th day of May, 1883, a member of the Philadelphia Councils stated before that body that this Brooks experiment cost $100,000, and had never worked at all; thereupon Mr. Brooks, who heard the statement, sent the following dispatch:—"To S. S. Bogert, wire chief of Western Union Telegraph Company, N.Y. How is the Jersey City Newark Underground Cable working that I laid last spring? Signed, David Brooks. Dated May 24th, 1883." To which Mr. Bogert replied as follows:—"David Brooks,—In answer to your dispatch, I have to say your Jersey City Newark cable laid last spring is working well. Our Newark duplex carrying the business of this and the main office at Newark is handled through that cable. Signed, S. S. Bogert." As Mr. Bogert had charge of those wires and Mr. Hamilton had not, perhaps Mr. Bogert knew as much about it as Mr. Hamilton. At any rate, as soon as Mr. Bogert's dispatch was read in councils something had to be done, and the wires were disconnected, and Mr. Hamilton says truly, "none of the conductors are now in use." If the Brooks system is good for nothing, why do they charge a fabulous sum for others to use it? Before they bought it they produced the opinion of their electrician, who stated it was worthless. This opinion was shown to the owners; yet, not heeding the advice of their electrician, they paid $190,000 for the American patents. What stupid people they are. When Mr. Bogert sent his dispatch to Philadelphia the cable had been working one year. It was laid in the Newark Marshes as an experiment, where they have no use for wires underground nor overhead, and it makes little difference what statements they make to prevent the company from being obliged to bury the wires. It is the honest belief of the subscriber that it is the cheapest, most durable, and every way the best system known.

H. C. Frempt, *Superintendent.*

Brooks Underground Conduit Company,
Philadelphia, *June 23rd*, 1885.

Electric Lighting in America.

On page 512 of your issue of June 6th, *a. c.*, I read that that part of the city of *Chicago* known as the Oil District is to be lighted by electricity by the Louisiana Electric Light and Power Company. This evidently refers to the city of *New Orleans*, where our company has closed a contract with the City Council for lighting the Oil District referred to. Please make the correction in your next issue and oblige.

W. Oswald,
Superintendent Louisiana E. L. & P. Co.

June 19th, 1885.

Secondary Batteries.

I had hoped that by confining myself as far as possible to facts I might have elicited from Mr. Howard and others who have had experience with the working of the Planté type of cells, information which would have been of general interest to your readers, and I can only regret that the correspondence on this most interesting subject should have assumed such a personal tone.

The experiments I made were quite unbiassed, as it is a matter of perfect indifference to me whether I am engaged in making Planté plates or the present E.P.S. type, having equal facilities for manufacturing either.

I can hardly, however, agree with Mr. Howard that the weight of lead required to give a certain discharge is of no consequence in determining the merits of batteries, even for lighting purposes, as it is evident that the *price* of the cell is to a great extent dependent on the amount of lead necessary for its construction, and I would venture to suggest that a customer would prefer to pay £2 16s. for a cell discharging normally at 30 ampères for ten hours, rather than £3 10s. for the same rate of discharge for four hours, provided the extra capacity is obtained at no sacrifice of durability, which I have little doubt will be proved to be the case.

I gave some figures of abnormal discharges made for a special purpose, which it is suggested that I should have done better to omit, *because I could not recommend them for regular work.*

Surely this is hardly to the point. It was implied that if a sudden call were made on the pasted type of plates, they *would not* give the current, whereas the unpasted plate *would*, and this, I think, my figures sufficiently disproved, but I should hardly suppose that the manufacturers of the Planté plates would themselves recommend their cells being constantly discharged at six times the rate given in the price lists, though in case of emergency the cells might be capable of giving the required current. The comparison, it appears to me, should be entirely one of effectual return and E.M.F. at different rates of discharge, as it must be known to anyone who has used secondary batteries that, if called upon to do so, they will give enormous currents.

I must thoroughly agree with the practical letter of Mr. F. Walker, and can assure intending users of secondary batteries that they will be much better off with a man who is willing to learn, and do what he is told, than with one of the old school who, according to their own showing, have been connected with so many failures in storage batteries.

Finally, I wish to make it clear that I am in no way anxious to depreciate Mr. Howard's paper as a description of batteries in the past, but am only anxious to show that since the paper was written storage batteries have not been at a standstill.

Bernard Drake.

I have been very much interested in Mr. F. Geere Howard's paper on the above, and the discussion thereon in your columns. I think that few electrical engineers who gave any attention to the subject, ever really doubted the practical utility of secondary batteries, or their ultimate success; but many of us probably anticipated difficulties in the early days of manufacture. I am not aware that this is a novel feature in the case of the apparatus of such a revolutionary character as secondary batteries.

In my opinion, however, one of the greatest drawbacks to their extended adoption is, no matter what may be the cause, the enormous price which is still charged for them. To put an enormous price upon a new article, about which little real practical information is obtainable, and whose life is uncertain, is to limit its sale to those few cases, in which other disadvantages are so great as to render the apparatus cheap at almost any price. In my own practice I have been exceedingly anxious to introduce secondary batteries on several occasions, but immediately we come to figures, we were obliged to give it up. In one case, at a large colliery in this district, we had a series dynamo running arc lights during the night, and it was hoped that it might be utilised for charging secondary batteries to light underground. The pit being a very deep one the conditions were, I consider, favourable to the secondary battery. Unfortunately, however, the price of the secondary batteries stood in our way, coupled with the fact that a special apparatus would have been necessary to prevent the accumulator reversing the poles of the dynamo, involving complication which was very undesirable. Eventually we fixed a dynamo and engine complete, underground, the latter being run by compressed air for about one fifth the cost of accumulators alone, with the farther advantage that we knew what we were doing and what to expect from the apparatus we fixed, and that the attention required was no more than could easily be furnished by the regular colliery officials.

I quite agree that there will be a very great future for secondary batteries in storing up the, at present, wasted forces of nature, and in utilising the margin of power and variation that always exists in factories, mines, ironworks, &c., where large engines are used, such as the blast engine at ironworks, the air compressing engine, and the fan engine at colleries, and so on. Unfortunately, however, at present rates, immediately you go into figures you are met by the fact that it costs far less to buy a separate engine than to buy an accumulator and run it from countershaft attached to the continuous running engine; and, in addition, it costs more to work, owing to the interposition of the power wasted between the engine and the lamps. You have also to consider that you are obliged to use a particular form of dynamo, and that if the lamps are to be worked from the accumulators alone, your dynamo must be larger than it otherwise would be, to make up for the waste in the former.

There is a point in the discussion that I should like to call attention to. Several writers have most strongly objected to Mr. Howard's rough and ready method of testing the batteries cell by cell, by means of a short piece of wire touched on the terminals for an instant. If I understand these gentlemen aright, they would lay the major part of the blame for certain not very satisfactory results, upon this method of testing. One correspondent, "Nemo," even goes so far as to liken it to plunging a knife into the coils of the dynamo. I should certainly feel very grateful to those gentlemen if they would enlighten us further as to what special feature there is in the construction or working of secondary batteries which leads to such disastrous results attendant on this method of testing. It certainly appears to me that unless secondary batteries have some such special feature, the test, in the absence of instruments, is about as good a rough and ready one as could be devised. It is one that is frequently used in connection with small dynamos, and was, in fact, about the only method of testing one lead for outside work before the invention of portable testing instruments. I can quite understand that if the attendant were testing all day long the accumulated result might be serious, but for once a day, for *an instant*, to short circuit a cell of two volts and observe the spark on breaking circuit again, I certainly fail to see where the mischief comes in.

If the low constant voltmeter referred to by Mr. Reckenzaun is at hand, and the attendant *can* use it intelligently, of course that would be the proper method, but, in my experience, that is just what outsiders cannot do, though they could employ the old test.

Sydney F. Walker.

July 4th, 1885.

[We are inclined to agree with Mr. Walker that a reduction in the price of secondary batteries would lead to their more general adoption.—EDS. ELEC. REV.]

Trembler Bells in Series.

Referring to the question of working trembler bells in series, I have had several sets of two working for many years past without any trouble. In my own house, I always have a bell in the kitchen and another in the servant's bedroom, both of which ring from any room in the house, and I have lately had an additional bell added to the front door bell, which is separate from the rest, so that the servant can hear if she happens to be in the garden. All of these are tremblers, and the only point to be looked to appears to be that the period of vibration should be as small as possible. In my experience, when this is very small, which can always be arranged in any well-made bell, the bells work well together. I have never had any demand for more than two bells in series in places where a trembler bell would be suitable, and I imagine that such cases would not be numerous.

The arrangement proposed by Messrs. Jolin is certainly ingenious, but the days are now long past since we had any trouble from sparking in a *well-made* trembler bell.

Sydney F. Walker.

July 4th, 1885.

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